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FOUNDRY TRADE JOURNAL

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What Every Ironfounder Should Know

If an ironfounder buys pig-iron—and but very few do not—then through the Joint Iron Council he pays a levy on what he buys. A substantial proportion of this is spent on research carried out by the British Cast Iron Research Association at Alvechurch, near Birmingham, and Blantyre, near Glasgow. The levy entitles ironfounders to become members of the Association by the mere completion of forms. Perhaps because of belief in the Yorkshire dictum "Owt for nowt is not worth having," quite a large number are content to do exactly nothing about formally joining the Association, despite the fact that in reality they *are* paying. We were encouraged to write on this subject, because at the annual meeting of the Joint Iron Council last week, a full-scale discussion was staged in order to give an obviously already enlightened audience details of the diverse activities undertaken by the Association. Moreover, the Association has issued a well-thought-out, nicely illustrated brochure* detailing all the aspects of its work, the plant employed, and the buildings housing this equipment.

It may be that some ironfoundry owners imagine that research, *per se*, is something that they cannot understand, let alone apply. Curiously, they believe that nothing practical can ever emanate from a laboratory. Since the war, the Association has gradually but persistently accumulated funds for the very purpose of bringing its work to the foundry "floor." Paradoxically, in France, at the *Centre Technique des Industries de la Fonderie*, the reverse policy has been in vogue and at their Sèvres headquarters more attention is to be given in future to fundamental work. Listed second in order of importance in the aims of the Association is "Giving practical advice on individual foundry problems," whilst fourth comes "Assisting in more efficient production and increased productivity of iron castings." Surely these statements should dispel any doubt remaining as to the endeavours of the Association in the realm of practical ironfounding.

As a high percentage of copies of this JOURNAL goes to ironfounders within the British Commonwealth, it is worth pointing out that they too are eligible for membership of the BCIRA, but as they do not pay the levy on pig-iron they have—in equity—to contribute their quota as an annual subscription. Another valuable service of the Association, though obviously this is available only to home members, is that provided by the Operational Research Team. Resulting from visits which the Team makes to iron foundries, free and confidential reports are made to the owner or board of directors indicating where both immediate and long-term improvements can be carried out to

* Available to readers on writing to Alvechurch

What Every Ironfounder Should Know

ameliorate existing conditions. At the moment, such visits are doubly worthwhile, as conformity with the new Regulations to come into being on January 1 must be uppermost in the minds of many foundry owners. If any doubts still remain in the minds of responsible ironfounders as to the wisdom of taking up the membership to which they are entitled, then they should assure themselves by visiting (by appointment) the Association's headquarters at Alvechurch. There they will get added enlightenment on " What Every Ironfounder Should Know."

Correspondence

DEFECTS IN CUPOLA-MELTED IRON

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—Mr. Morgan's observations on cupola-melted iron in your correspondence columns of October 27 are rather interesting and the experience of his colleagues relative to gas-hole defects in castings has been shared by other foundrymen. Several years ago, the writer investigated the cause of an epidemic of gas holes in grey-iron castings. The symptoms were:—A strong smell of SO_2 issuing from the metal at the spout and during pouring; " mercurial " working of top layer of metal in the gate after pouring, and chemical analysis of the castings involved indicated that the sulphur content was high in relation to the manganese (as deduced from the conventional formula).

The first step towards correcting this was thought to be the introduction of more manganese to the cupola; ferro-manganese was therefore added. As this addition to the cupola was increased, so did the manganese in the castings increase. The increase, however, did not equate the manganese and sulphur for the latter rose until one analysis showed manganese 0.8 per cent., sulphur 0.17 per cent. The smell of SO_2 was more in evidence, and the number of gas holes in the castings increased alarmingly. Additions were promptly discontinued.

Examination of the cupola practice showed that the metal charge proportion was considerably lower than it should have been; this meant, relatively, that limestone and coke charges were exceptionally high. When the metal, coke and limestone charges were corrected, the incidence of gas holes fell considerably and manganese contents fell to a normal figure.

Since this occurrence, it is the practice to keep off manganese additions as much as possible and certainly not attempt to equate manganese and sulphur in the accepted manner.—Yours, etc.,

T. HUME CAULFIELD.

Allied Ironfounders, Limited,
Central Laboratories,
Falkirk.

November 1, 1955.

IT IS BELIEVED THAT the first time any branch of the Institute of British Foundrymen—or indeed the Institute itself—has held a Press conference, was on the occasion of the celebration by the Lancashire branch of its golden jubilee. The event will be fully reported in next week's issue of the JOURNAL.

Survey of Birmingham Industry

In a survey of small manufacturing companies in Birmingham, carried out recently by the Oxford University Institute of Statistics, almost 80 per cent. of the companies surveyed were in the metal-using industries. On average they employed 64 workpeople, their net sales in a year were £101,000, and their total assets averaged £86,000—although at the extremes 13 employed fewer than 20 people and three more than 200. More than half of the companies sold their goods nationally but 31 sold mainly in the local market. All but about 8 per cent. stated that they were faced with price competition. Twenty-four of the 85 firms co-operating in the survey were able to finance themselves out of profits and had never tried to raise money outside. Since 1947, less than half of all the 85 firms have notably increased their turnover in spite of its being a period of great industrial expansion.

The survey put forward some possible explanations for the apparent unwillingness of many companies to expand. The acute labour shortage in Birmingham is one. Another is the fact that only about two-fifths were working to full capacity, while another two-fifths had spare capacity amounting from 20 to 50 per cent. In more than three-quarters of the firms, one family had a majority interest, two-fifths of them were completely owned by one family, and nearly 17 per cent. had been in the same hands since the first world war. Just over half the companies were founded before the first world war, 42 per cent. of them before the end of the 19th century.

Forty Years Ago

In the issue of the JOURNAL for November, 1915, the Editor discoursed learnedly on the possibility of making aluminium gravity- or pressure-die-castings. He was obviously not too clear as to American nomenclature embracing such expressions as permanent mould for the former and confining " die-castings " to the second. He did state that he had seen aluminium die-castings being made in this country, yet the impression was given that the process was newish. It was interesting to read that only by adding large percentages of lime to a cupola charge could the sulphur be reduced. The solution of this problem had to await the early post-war years. The death of Sir Andrew Noble at the age of 85, was recorded. The registration of Chatwins, Limited—now a subsidiary of Hale & Hale (Tipton), Limited—was announced.

Dinner

BRITISH BRONZE & BRASS INGOT MANUFACTURERS' ASSOCIATION

The annual dinner/dance of the British Bronze & Brass Ingot Manufacturers' Association was held last Saturday at Grosvenor House, Park Lane, London. Mr. G. T. Whitehouse, the president, was in the chair. With him at the high table were Mr. F. J. Errol, M.P., Parliamentary Secretary, Ministry of Supply; Mr. C. F. Bayliss; Mr. L. H. Cleaver; Mr. B. T. Davies; Dr. A. B. Everest; Mr. G. T. Field; Mr. O. G. Halliwell; Mr. T. B. Henderson; Mr. W. T. Hobkirk; Mr. L. Lazarus; Mr. W. H. Plant; Mr. T. F. Turner, most of whom were accompanied by their ladies. During the evening, the gathering was entertained by George Braund (magician) and Alex and Dita Aldott (acrobatic dancers).

Patterns Cast in Epoxy Resin*

By D. B. Orr.

The principle of cast patterns made in synthetic resin is not new and the extension and development of the practice has been dependent on a resin with the qualities necessary for accuracy of detail and dimension, good surface, strength and ease of handling. The post-war development of epoxy† or ethoxyline resin has provided an answer to these requirements.

For various reasons, mainly for machine moulding—replicas of master patterns are often required by the foundryman. These may be made in wood or metal as separate patterns or in metal, plaster or plastic stone, cast integrally with a plate. When made in wood or metal, whether as separate patterns or as "plated" patterns, the labour costs are high. It is this cost that is substantially reduced when cast resin patterns are made. The essence of the process is that epoxy casting resin will give perfect reproduction of a mould surface, even to paint-brush marks. If a mould is made from a master pattern in plaster or low-temperature sprayed alloy, then the replica cast in resin will be an accurate reproduction in detail and in dimension, for this casting resin sets at room temperature and the fillers used reduce the slight contraction to zero or a negligible amount. The process of making a resin casting is very simple "cookery"—the mixing of a given percentage of hardener with the resin and the addition of filler to suit the work in hand. The resin looks like thick syrup. The appearance of the casting is given by whatever filler is used.

The purpose of this Paper is to give some details of the adaptation of a simple process to meet diverse pattern requirements, to describe "know-how" and admit limitations. Broadly speaking, resin is suitable for casting any kind of split pattern. In other words, a pattern where the upper horizontal face is not a moulding face. This limitation is set because despite care, resin/filler/hardener mix is bound to contain entrapped air and some bubbles will migrate to the upper surface giving slight pinholing. It may be possible to obviate such defects by various devices such as the addition of filler to resin the day before use, vacuum treating the mix before casting, casting a closed mould at an angle to reduce the area of pinholing, or by arranging a "riser" if it can be effectively positioned to include most of the entrapped air. In general, however, the casting of complete patterns or models is much more difficult than split patterns. For the same reason, double-sided plates present difficulties and this special problem will be considered later.

It will be noted that there is a close parallel with pressure-cast aluminium plates—with one important difference—the shrinkage of this resin is negligible. Thus, if master patterns with double contractions already exist, then resin will not serve as a medium for the working pattern or plate; but if the master pattern available has only the final contraction, then the operation of making a double-contraction pattern can be saved, by casting in filled resin.

* Presented to the Slough section of the London branch of the Institute of British Foundrymen, Mr. J. Wood presiding.

† All the work described in this Paper was done on Araldite casting resin M and an amine hardener known as 951—Araldite being a trade name belonging to Aero Research, Limited, the firm with which the Author is associated.

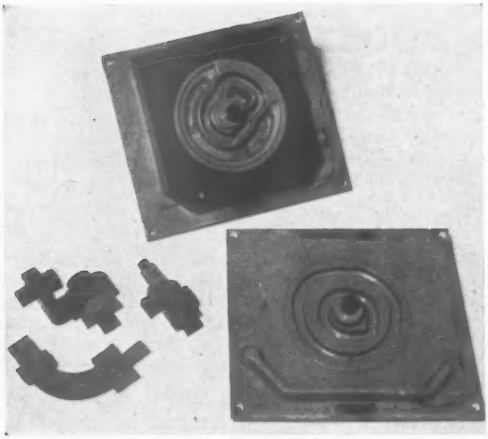
Moulds

1. *Plaster*

If the master pattern be in good condition and devoid of undercuts, then plaster is the easiest material to use for moulds. After setting, the moulds must be thoroughly dried of all free moisture. (The word "free" is used in distinction from the combined water in the crystals of plaster of Paris. If casting aluminium, it is essential to drive off this combined water by high temperature for a longer period, because the heat of the metal would liberate the water of crystallization.) The hardener used to set the resin is hydroscopic, and residual moisture in the mould results in a "cheesey" surface on the cast pattern. Plaster moulds can be dried in a core stove. It should be noted that any grade of plaster which reproduces an accurate negative of the pattern is suitable for casting resin, but if a plaster specially supplied for pressure-cast aluminium plates is used, the water addition should be reduced to the minimum needed to give a pourable mix. The excess water normally used is designed to give permeability to the mould. The weakness of these plaster moulds is acceptable in casting aluminium, but is unserviceable when preparing such a mould for casting resin. The surface of the dried mould must be sealed and coated with a release agent and a conventional wax-polish dissolved in a solvent such as carbon tetrachloride is suitable. When dry, a thin coat of petroleum jelly softened with paraffin is desirable.

2. *Sprayed Metal.*

Low melting-point alloys can be sprayed on any pattern provided it is free from undercuts and unpainted or has a heat-resistant paint. The best method is to mount the pattern on a base around which a frame can later be placed so that the metal can be backed with plaster. (Low-melting-point alloys cost about 15s. a lb. and the spray gun about £45 and approximately 70 per cent. of the metal is recoverable). More than one cast pattern could be taken from such a mould, but the setting time for the resin would produce only one pattern per day. The advantage of a sprayed metal-mould might be a time saver in producing say a "plated" pattern in that the plaster backing would only need to set; the drying operation could be omitted.



[Courtesy of S. Russell & Sons, Limited, and Ransomes Sims & Jefferies, Limited.

FIG. 1.—*Patternplates 15 by 13 in. cast in filled epoxy resin. The moulds for these were made in resin-hardened sand. The patterns are reinforced with heavy-gauge expanded metal.*

3. *Sand Moulds.*

A method of casting resin patternplates in sand moulds has been developed by S. Russell & Sons, Limited, of Leicester, in co-operation with the Author. Sand moulds have their main advantage when imperfect master patterns have to be used. Briefly, the pattern is rammed-up hard in Mansfield sand and after withdrawing the pattern, the mould is carefully "touched up." The mould is liberally sprayed with a 50 per cent. solids urea formaldehyde resin (a core binder U.F. will do) and the mould is thoroughly dried in the core stove. The surface becomes rock hard. When dry, a second coat of U.F. resin with hardener added is applied by brush. If the mould be still warm this coat hardens within minutes and a glassy surface can be obtained by repeated coats but without affecting the dimensions of the mould. The surface is finally waxed. Examples of this type of pattern are shown in Fig. 1. Promising experiments have been made with sand moulds hardened by the CO_2 Process to save drying. A fine sand must be used. Because the surface will be alkaline, the sealing process must be done with a resorcinol resin. Silicate of soda would serve, provided the residual moisture was dried out.

Casting the Resin Pattern

The resin is best cast into the open mould, and any cover plate can be placed on top later. The viscosity of the mix, *i.e.*, the amount of filler added, is governed by the intricacy of the pattern, *e.g.*, 100 per cent. filler on resin may be enough if there are sections only ¼-in. thick, whereas a simple shape may be poured with nearly 200 per cent. filler by weight on the weight of resin.

Numerous fillers are used. Silica flour and slate powder give a very hard surface but present machining difficulties, *e.g.*, milling the back of the pattern may be desirable; drilling and tapping may be necessary. Marble flour and various forms of chalk are probably most convenient. Aluminium powder will give a metallic appearance.

Reinforcing Materials and Methods

This is an extensive subject and one which gives plenty of scope for the patternmaker to exercise his skill and ingenuity. The following is an attempt first to explain what is the object of reinforcing and second to indicate methods of achieving the result. No foundryman will quarrel with the generalization that wear and tear of pattern equipment falls into two classes—use and abuse. Under "use" there are sand abrasion, the shocks and stresses of the various jolt/squeeze machines, and the venting of moulds with vent wires. "Abuse" refers to accidental drops, careless stowage, and blows of all kinds on the moulding machine whether from boxes or ramming tools.

Cutting across the above categories, reinforcing might be sub-divided into three types:—(1) Reinforcing of a cast resin-plated pattern to give the necessary increase in tensile or flexural strength to withstand the shocks of a jolt/squeeze moulding machine; (2) "local" reinforcing of protruding parts on the face of a pattern to withstand accidental blows; and (3) reinforcing of the main body of a pattern and/or of the moulding face to increase impact strength. In general, this is an extension of (2) and is designed to deal with the abuse of patterns so often encountered in mechanized foundries. Separate patterns, fixed to a plate, and patternplates which are supported by a base or grid arrangement on the moulding machine need not be reinforced. Separate patterns made a year ago at Ransomes Sims & Jefferies, Limited, have produced some thousands of moulds over the past twelve months. Those patterns had no reinforcement. S. Russell & Sons, Limited, of Leicester, made half-plates at the same time only ¾-in. thick without reinforcement which were satisfactory on a moulding machine with a grid-type of support underneath.

Reinforcing of a casting is achieved by the incorporation of a proportion of a material with a high-tensile strength. It may be in the form of rods or expanded metal in a technique similar to reinforced concrete, but to preserve the virtue of lightness in weight or to follow contours (*e.g.*, in the case of a pattern with a broken joint-line) it is better to use a fibrous material like glasscloth.

To extend the description of reinforcing methods, the following information can be cited as typical:—

1. *Reinforcing of a patternplate against jolt/squeeze action.*

The pattern can be considered as a beam and, therefore, with the pressure of the squeeze coming on the pattern face, it follows that the under side will be in tension and it is this section of the plate which should incorporate reinforcing material. The undernoted details a method of carrying out this operation in a flat-backed patternplate. A suitable thickness would be ½ in. or ⅝ in. although a

thinner plate might be used if more glasscloth were laid up.

(*a*) A frame, the thickness of the plate (say $\frac{7}{8}$ in.), coated with wax-release agent is placed round the prepared plaster mould.

(*b*) On the plate portion of the plaster are placed four "chaplets" of metal or of cured resin $\frac{7}{16}$ in. high (half the plate). On them will rest a sheet of expanded metal of small mesh.

(*c*) Pour the resin/hardener/filler mixture into the mould until level with the "chaplets."

(*d*) Place the expanded metal on the chaplets. (The expanded metal will act as an additional reinforcement, but its object is to form a base for layers of glasscloth which should be in this top section of the plate.)

(*e*) Using rubber gloves as a protection, dip the rectangles of glasscloth, cut to plate size, in the remaining resin/filler mixture so that each piece is thoroughly wetted. This is a messy operation but experience shows it to be essential. Resin, even without filler, will not wet the glass fibres properly without some movement, or pressure/disturbance. Four to six layers of an open-mesh cloth have been found to be sufficient in practice for plates 18 in. × 13 in. Some extra small pieces should be incorporated at dowel and securing hole areas.

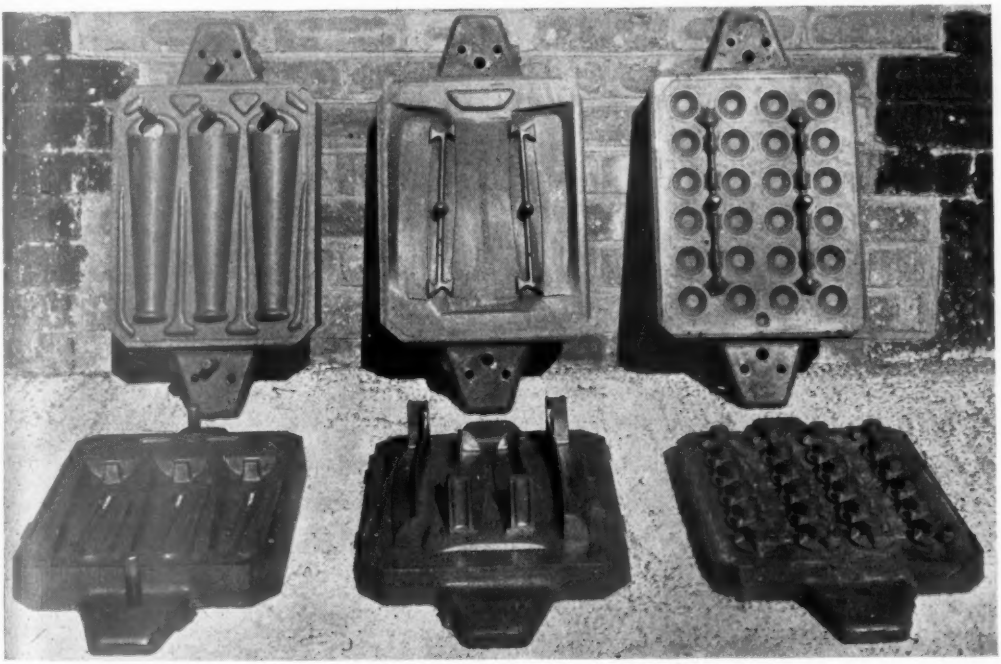
(*f*) Fill the mould level with the frame.

(*g*) To give a flat surface it is necessary to close the mould. Use a lid of wood or metal with a true surface. It is best to have one or more tapered holes about 1-in. dia. The lid is placed on the frame and a final topping up through the holes will compensate for entrapped air which will slowly leave the casting. This top surface, or back of the plate will almost certainly have some air pockets but they should not prevent a true level for fixing to the machine bed.

If the patternplate has a broken joint-line then there will be modifications to the above. There will be top and bottom halves of the mould. A grade of thin flattened expanded aluminium can be used which is ductile and may be pre-moulded to the pattern contour. Holes to act as runners must be made in both the expanded metal and in the glasscloth. The material must still be soaked in the resin placed on the expanded metal and the mould closed. The casting will be run from the highest point or points. Examples of finished patternplates are shown in Fig. 2.

FIG. 2.—*Group of cast-resin patternplates, the middle pair having metal patterns set in a resin bed* (vide JOURNAL, *February* 10, 1955, *p.* 141). *Right and left are patternplates entirely cast in resin, with an iron frame.*

[Courtesy of Shaw Foundry Company, Limited.



[Courtesy of Ransomes Sims & Jefferies, Limited.

FIG. 3.—*Broken-joint-line patternplates measuring 23 by 13 in. cast in plaster moulds. Brass bushes were located and cast in the resin.*

It should be noted that it is convenient here to deal with a question so often raised by foundrymen and patternmakers: "Can the mould be vented?" A comparison is made with the casting of metal. Vents can be used but not with the same effectiveness as with a metal cast, for several reasons. The resin, filled or unfilled, is much lighter than metal; the viscosity is higher than molten metal; the entrapped air is released slowly, and vents, unless leading to a point higher than the top of the casting act more as leakage points.

Double-sided patternplates.

The difficulties of double-sided plates have been mentioned. If the plate required has a "positive" pattern on each side then one of two methods can be used. The simpler method is to make two single-sided plates and stick (with epoxy resin) and dowel them together. Alternatively, a thin coating of paste consistency can be applied to each half of the mould and allowed to gel. The mould is then closed and cast vertically from runners at the side. It would not be difficult to incorporate reinforcing material into such a mould.

The most difficult job to tackle is the double-sided plate with a broken joint-line (Fig. 3). The gel-coat technique may be practicable but reinforcing may be difficult, perhaps impracticable. On the other hand, the squeeze action on a double-sided plate is often simultaneous, top and bottom, and the tensile or flexural strength need not be so great. Here is a case where the resin maker cannot solve the diverse problems of a craft; he can but "provide the tools," and leave the patternmaker to finish the job.

2. *Local reinforcement*

Local reinforcement is comparatively simple. Any protruding part which has a thin section can be filled with the resin/filler mix and then wetted glasscloth can be pushed in. The resin should go in first to ensure wetting of the mould surface and to prevent air pockets. The glasscloth will extend into the main body of the pattern and in this way even a thin section—of $\frac{1}{8}$- or $\frac{1}{4}$-in. thick—can be made resistant to heavy blows. If it is desirable to reinforce a shall protruberance, then two or three layers of material, always pre-wetted with the mix, can be placed on the mould surface. To prevent these "floating" in the resin, a piece of expanded metal can be placed on top to keep the fibrous material in position. Glass fibre has a high-tensile strength, but cotton or linen fabrics, of open weave to allow wetting, might serve very well. Laboratory experiments are being made with absorbent Kraft papers. Another useful material is Minimesh, a fine-mesh expanded metal which could be described as a gauze. It is made in mild steel and can be neatly pre-formed, *e.g.*, a round boss, perhaps a core print which incorporates a surface "cylinder" of Minimesh, thereafter filled with folded glasscloth, would withstand a blow that would easily break cast iron. Examples of reinforcing material are shown in Fig. 4. This local reinforcing could be extended to cover almost the entire face of any pattern, whether loose or plated, and in this sphere the patternmaker can exercise his craft and ingenuity. For example, he might soak some glasscloth of fine weave in the resin and lay this on the mould surface, backing it with more open-weave material and finally with ductile expanded metal. The cured pattern surface would then have excellent impact resistance.

3. *Reinforcing the main body of the pattern.*

Such general strengthening may be necessary to meet the demands of the foundryman with long runs. There is no evidence of wear of patterns up to 4,000. It is the Author's belief that many times that number would still show little wear, but the abuse mentioned earlier leaves a challenge to be met. Broadly, the increased impact strength may be imparted by altering the character of the resin by making it slightly "rubbery," or by incorporating fibrous filler. Unfortunately, the desirable and the practicable are here in conflict. Some of the resin combinations with higher impact strength are more viscous—and thus less convenient to pour at room temperatures—and small percentages of fibrous fillers soon produce a similar apparent increase in viscosity in the mix. With chopped strand of glass fibre, 3 per cent. is as much as may be used. With asbestos fibre, 6 per cent. is about the limit and of course other filler is absent in these experiments. The effect is disadvantageous when pouring any intricate parts of a pattern. The solution to this problem probably lies in combining "local" or surface reinforcing with a resin of improved impact strength. Alternative fibrous fillers are now being offered and experiments are in hand and two promising techniques may be des-

cribed. One is simply the use of glass fibres specially milled or cut to very short lengths—up to approximately ¼ in., but most of them much less than this. Eight per cent. by weight of such fibres can be added to a mixture of 100 parts resin and 100 per cent. marble flour to give a pourable mix. When 12 per cent. fine glass fibre is added (on weight of resin) the mix becomes a workable paste. Test-pieces made with this mixture show a considerable increase in impact strength and the surface resistance to impact is excellent.

A second casting method is one identical to that used by the makers of plastic press tools, and casts the surface skin of the pattern after the main body; if preferred, this skin may be a different composition of resin and filler.

(*a*) The mould is lined with a layer of plasticine about 1/16- to ⅛ -in. thick.

(*b*) On this layer the mould is filled with resin/marble flour/glass fibre, and the highest possible amount of glass fibre, plus glasscloth and/or glass rovings can be incorporated.

(*c*) After hardening, this pattern "core" is removed and any grease from the plasticine is removed with a solvent or detergent. It should be noted that if several patterns were required it would be worthwhile to make moulds of the "pattern core" so that the remainder of the "cores" could be cast at one time.

(*d*) The plasticine is removed from the mould and wax release is applied to the mould surface.

(*e*) The surface mixture is poured into the mould. The amount will involve some guesswork but an excess must be allowed. For very long runs, say 50,000 or more, it may be an advantage to cast this skin in resin filled with slate powder or silica flour, plus about 10 per cent. of graphite, but information as to the wearing properties in foundry conditions is not available in the case of such hard fillers.

(*f*) Place the pattern core in the mould and press slowly into position. If the "core" has been cast with a slight "flash" or overflow, then it will suspend itself in the correct position. The back of the pattern will still need to be milled or surface ground. On no account should a reverse of upward movement be given to the "core" or air may be sucked back to form a surface air pocket.

(*g*) Cure the complete casting in the standard way. (The double curing cycle—of "core" and skin does not harm.) It is well to emphasize that the standard set in this category is high. A pattern well-reinforced with glass fibre in the right places will compare most favourably with cast iron, in many of its qualities, not least in impact strength.

Pouring the Resin Mix

It is an advantage to add filler to the resin the day before, as this allows much of the entrapped air to escape. The hardener is added (between 8 and 9 per cent. on weight of resin) just before casting, and extra care must be taken to ensure thorough mixing when the filler is already present. Surface tension will permit the mould to be filled with a convex maniscus, *i.e.*, with the surface of the resin higher than the mould surface. During the next hour, a little more air—included in the hardener stirring operation—will emerge. A lid can then be placed over the mould as previously described. Some foundries prefer to machine the back of the pattern while still in the mould and therefore let the cast pattern harden in the open mould. A patternplate should always have a top to close the mould; there is bound to be some exotherm and it is desirable to keep this as even as possible throughout the casting.

Curing or Hardening of the Cast Pattern

The resin/hardener combination cures at room temperature. In 24 hours it will be fairly hard, but will not reach full hardness for two or three days. The time depends on the shop temperature and on the mass of pattern; a large mass will harden more quickly than a smaller because of exotherm. The most satisfactory way to complete the cure is to allow the resin to gel—it does this within 6 hours—and then apply moderate heat if available, *e.g.*, six hours at 40 deg. C. or three hours at 60 deg. C. are suitable conditions. The

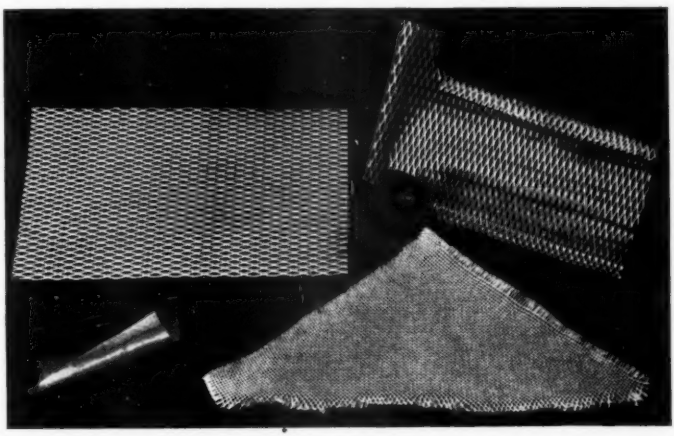


FIG. 4.—*Examples of reinforcing material :—(Above) flattened expanded aluminium and (below) Minimesh and an open-weave glasscloth.*

Patterns Cast in Epoxy Resin

cast should be kept in the mould until cure is complete.

Release of pattern from mould

The simplest method is to break the plaster mould even if release is efficient. In the case of a metal mould, it will probably be necessary to draw the pattern out by bolts screwed into tapped holes in the base of the pattern.

Finishing

A cast resin pattern will require little or no machining. If the "lid" technique has been mastered then the back may give a perfect joint-line, or it may be milled if preferred. One foundry reports that, even with a chalk filler, they found the cast pattern rather hard for a wood-working milling tool and used a tipped tool. If the mould has been perfect and the amount of filler has been suited to the job, there should be no imperfections on the face. If at any time a pattern has to be repaired, or altered, then a "putty" or paste of resin and filler plus hardener can be used to fill or build up. The resin is an almost universal adhesive; it adheres to metal and to several cured resins—provided any trace of wax or grease is removed.

Surface finish

If the mould permits, the wax release can be polished—and an equal polish will be reproduced on the pattern. The shape and size of many moulds will not allow for polishing and, if desired, the cast pattern will respond to light rubbing with a fine abrasive paper. The stripping qualities of resin patterns are good and reported to improve with usage. The low thermal conductivity of the material prevents condensation or sweating on the surface when warm sand has to be used.

Cost

The cost of the filled resin is around 4s. to 6s. a lb., depending on proportion of filler added; glasscloth is approximately 6s. to 8s. a sq. yd.; and the expanded metal referred to is about 1s. 6d. a sq. ft. The capital cost involved is less than £1—an enamel measuring jug of resin, a glass measuring cylinder for hardener and a pair of domestic rubber gloves. A winchester of acetone for cleaning up is useful.

The supreme claim for this new patternmaking material is the reduction of cost through large saving of the labour of finishing time. Following close on this are speed and adaptability. Ransomes, Sims & Jefferies, Limited, have made a working pattern from an old casting and sand cores, and one from a pattern which did not fit their machine, each within three days.

Ethoxyline resin is a comparatively new material. For patternmaking it is a substitute for wood or metal; but "substitute" should be understood literally and not as implying "ersatz" or sub-standard, any more than nylon yarn is so judged.

Judged in this spirit and developed with imagination there is now at hand a versatile and adaptable material to aid foundry management and pattern-makers in coping with the production of machine patterns.

Acknowledgment is made to the directors of Aero Research, Limited, for permission to publish this Paper.

* * * * *

At the Slough section meeting, when this Paper was presented, Mr. Orr was accompanied by Mr. Mann, of Ransomes Sims & Jefferies, Limited, Ipswich, who has had considerable experience with the development and practical application of cast epoxy-resin patterns. Mr. Mann was enthusiastic about the new material and contributed much to the discussion. Besides the illustrations shown, the lecturer exhibited a number of production patterns of varying degrees of complexity cast in the resin, in addition to samples of the reinforcement materials described.

Census of Production Requirements

An Order giving details of the requirements of the census of Production for 1955 has been made by the Board of Trade. The census will be taken in 1956 and will be on a sample basis similar to the censuses for 1952 and 1953.

Undertakings producing coal, gas, electricity, oil-shale, crude or refined petroleum, or shale-oil products are exempted from making census of production returns to the extent to which they supply the necessary information to the Minister of Fuel and Power (or in certain cases to the Secretary of State for Scotland). Since the arrangements for the 1955 census were announced last year the sampling scheme has been modified so that firms engaged in mining and manufacturing employing 10 or fewer persons will not now be required to make returns.

The Order, which operates from December 31, is the Census of Production (1956) (Returns and Exempted Persons) Order, 1955, and copies may be obtained from the Stationery Office, or through any bookseller (price 2d.).

Indian Industries Fair

British participation in the Indian Industries Fair, which opened at New Delhi on October 29, includes a British pavilion occupying 38,400 sq. ft., containing exhibits by 18 firms. This pavilion has been organized by a commercial firm, and among the exhibits are iron and steel products, chemicals, aircraft equipment, sugar machinery, earth-moving equipment, agricultural machinery, diesel engines, and gas turbines. One of the stands is taken by the United Kingdom Trade Enquiry Bureau (*i.e.*, a British Government stand) occupying 890 sq. ft. Apart from enquiry facilities, the stand consists of a display, which is divided into six sections, devoted to railways, steel, man-made fibres, broadcasting, electronics, and mining. The purpose of the display is to show some of the latest products of British craftsmanship, industrial skill and scientific knowledge which can contribute to the development of India. In addition, there is understood to be a considerable number of British firms exhibiting in the Indian section of the Fair, mostly through their Indian subsidiaries.

Institute Elects New Members

At the Council meeting held at Manchester on October 15 this year, the following were admitted to membership of the Institute in the grades indicated below:

AS SUBSCRIBING FIRMS

Hilger & Watts, Limited, Langston Road, Loughton, Essex (Representative: H. F. Box).
Mukand Iron & Steel Works, Limited, Bombay, India (Representative: R. M. Agrawal).
Stone & Burton Company, Limited, Windsor House, 46, Victoria Street, London, S.W.1 (Representative: E. C. Evans).

AS MEMBERS

J. F. Agnew, Staveley Iron & Chemical Company, Limited, Chesterfield.
R. M. Agrawal, Mukand Iron & Steel Works, Limited.
W. C. Best, Tilghman's Limited, Manchester.
J. L. M. Bevan, Baglan Engineering Company (1919) Limited, Neath, Glam.
G. V. Bhatt, Indian Smelting & Refining Company, Limited, Bombay, India.
W. G. Boustred, Scaw Metals, Limited, Johannesburg, South Africa.
M. I. Chowdri, Pakistan Ordnance Factories, Wah Cantt., Pakistan.
J. P. Cummings, International Harvester Company of Great Britain Limited, Doncaster.
E. C. Evans, Stone & Burton Company, Limited.
H. H. Fairfield, Millspaugh Limited, Sheffield.
R. E. Few, G. D. Peters & Company, Limited, Slough, Bucks.
J. Frith, Crumbiehulme, Limited, Bolton, Lancs.
E. A. Gardner, W. J. Wesley, Coventry.
Dr. E. Gregory, Edgar Allen & Company, Limited, Sheffield.
P. C. Gupta, Hindustan Shipyard, Limited, Vishakpatnam (Andea State), India.
B. R. Higgins, Yorkshire Engineering Supplies, Limited, Leeds.
G. A. Hodges, Kent Alloys, Limited, Rochester, Kent.
C. F. Hollylea, Great Bridge Foundry Company, Limited, Great Bridge, Worcs.
S. W. Hyde, General Electric Company, Limited, Erith, Kent.
T. G. Jackson, Jackson Brothers (Milton) Limited, Stoke-on-Trent.
W. K. James, Bridge Foundry Company, Limited, Wednesbury, Staffs.
A. G. Jones, Broom & Wade, Limited, High Wycombe, Bucks.
D. G. Jones, Mond Nickel Company, Limited, Millbank, London, S.W.1.
K. C. Jones, Tiverton Foundry Company, Limited, London, N.15.
G. B. Judd, Mann, Judd & Company, London, W.C.2.
J. Knight, Tame Valley Alloys, Limited, Nr. Tamworth, Warwicks.
A. A. Marsh, T. H. Dick & Company, Limited, Hull.
N. H. Sturgess, International Combustion Africa Limited, Port Elizabeth, South Africa.
S. Thegel, Burmeister & Wain, Copenhagen, Denmark.
F. J. Thomas, Milford Haven Dry Dock Company, Limited, Milford Haven, South Wales.
A. E. Thornton, Firth-Vickers Stainless Steels, Limited, Sheffield.
W. H. T. Warren, J. & S. Eyres, Limited, Manchester.

TRANSFERS FROM ASSOCIATE MEMBER TO MEMBER

E. Morgan, Stanton Ironworks Company, Limited, Nr. Nottingham.
J. R. M. Richards, A. Hamilton & Sons, Limited, Cardiff.

TRANSFER FROM ASSOCIATE TO FULL MEMBER

M. A. Edwards, Pentrebach Road, Pontypridd, Glam.

AS ASSOCIATE MEMBERS

C. M. Akram, Pakistan Ordnance Factories, Royal Arsenal, Woolwich, London, S.E.18.
E. J. Bailey, Glamorgan Technical College, Treforest, Glam.
S. Banks, H.M. Prison Commission, H.M. Borstal Institution, Nr. Doncaster.
A. J. Boothroyd, Stanton Ironworks Company, Limited.
F. Calford, Curran Steels, Limited, Cardiff.
S. N. Chatterjea, Siemag Buschhutten (Krs. Siegen), Germany.
A. N. Chatterjee, Assistant Inspecting Officer, Government of India (Calcutta Circle), Jamshedpur, India.
P. Chockalingam, Sree Meenakshi Mills, Limited, Madurai, Southern India.
R. Clint, R. Blackett Charlton & Company, Limited, Newcastle-upon-Tyne.
S. G. Cooke, Pickford, Holland & Company, Limited, Sheffield.
A. W. Cottrell, R. J. Richardson & Sons, Limited, Birmingham.
A. Ford-Robertson, engineering consultant, Buenos Aires, Argentine.
T. W. Forrester, W. H. Smith & Company (Whitchurch), Limited, Whitchurch.
R. Fraser, Wilson Pipe Fittings, Limited, Glasgow.
J. F. Glew, Wm. Cumming & Company, Limited, Chesterfield.
R. A. Hailstone, Britannia Iron & Steel Works, Limited, Bedford.
R. Hill, Massey-Harris, Limited, Manchester.
S. Hill, Acme Conveyors, Limited, London, S.W.3.
J. W. Lessells, W. Lessells & Company, Northampton.
D. W. Longstaff, Darlington Forge, Limited, Darlington.
K. H. D. W. Muir, Argus Foundry, Limited, Glasgow.
A. R. Mukerjee, Ordnance Factory, Muradnagar, U.P. India.
A. E. Newman, London Transport Executive, Charlton, London, S.E.7.
A. H. Patterson, James Brown, Limited, Natal, South Africa.
P. Potter, British Bath Company, Limited, Greenford, Middx.
J. Ratcliffe, Bridge Foundry Company, Limited, Wednesbury, Staffs.
J. Ridley, A.P.V.-Paramount, Limited, Crawley, Sussex.
R. F. Rosoman, John Williams & Sons (Cardiff), Limited, Cardiff.
H. B. Sheridan, N. Isherwood & Company, Limited, Bolton.
J. W. Siebert, Ford Motor Company, Limited, Dagenham, Essex.
R. S. Simkin, N. Isherwood & Company, Limited.
K. Skrinivasan, Shree Ram Mills, Bombay, India.
J. F. Soakell, Criteria Cycles, Middlesbrough.
M. T. L. Sterley, East Rand Engineering Company, Limited, Benoni, South Africa.
G. Tait, R. Blackett Charlton & Company, Limited.
W. Thompson, Stanton Ironworks Company, Limited.
L. B. Turner, Incandescent Heat Company, Limited, Smethwick, Staffs.
M. H. Walker, Rowe, Jewell & Company (Pty.), Limited, Brakpan, South Africa.
J. Whittaker, Jackson & Brother, Limited, Bolton.
H. Wilkinson, Wm. Whiteley & Sons, Limited, Huddersfield.
K. J. Williams, Cardiff Foundry Company, Limited, Cardiff.
G. G. F. Wiseman, Pneulec, Limited, Birmingham.
C. A. Woodman, Signals Research & Development Establishment, Christchurch, Hants.
D. E. Worth, Harold Andrews Grinding Company, Limited, Halesowen, Worcs.
R. Wright, English Steel Corporation, Limited, Sheffield.

TRANSFERS FROM ASSOCIATE TO ASSOCIATE MEMBER

W. Amos, Qualcast, Limited, Derby.
R. A. Boustred, Scaw Alloys, Limited, Johannesburg, South Africa.

ASSOCIATES (over 21)

A. S. Bhatnager, Texmaco Gwalior, Limited, Gwalior, India.
W. V. Blackwell, S. Russell & Sons, Limited, Leicester.
A. K. Chrakraborty, Shellac Industries, Limited, Calcutta, India.
L. J. Crowe, Renshaw Foundry, Limited, Staines, Middx.
W. R. Gillies, Smith & Wellstood, Limited, Bonnybridge, Scotland.
H. G. Guest, Morris Motors, Limited, Wellingborough.
L. Hall, Richardsons, Westgarth & Company, Limited, Hartlepool, Co. Durham.
Jean-Louis Jeanneret, National Foundry College, Wolverhampton.
N. S. John, John Williams & Sons (Cardiff), Limited.
W. T. Muscutt, Sterling Metals, Limited, Coventry.
A. K. Omar, Brockhouse Castings, Limited, Wolverhampton.
J. Oulton, David Brown Machine Tools, Limited, Manchester.
K. Parker, John Williams & Sons (Cardiff), Limited.
R. I. Sethna, Shree Ram Mills, Limited.
J. Shields, Davy & United Roll Foundry, Limited, Billingham-on-Tees.
D. V. Talwar, Northern Railway Workshops, Jodhpur, India.
B. O. B. Williams, John Williams & Sons (Cardiff), Limited.

ASSOCIATES (under 21)

M. C. Biswas, Kumardhubi Engineering Works, Limited, Bihar, India.
A. Crowther, Crossley Brothers, Limited, Openshaw, Lancs.
E. Elvin, North Eastern Marine Engineering Company (1938), Limited, Wallsend-on-Tyne.
M. Evans, Guest, Keen Baldwins Iron & Steel Company, Limited, Dowlais, Glam.
G. R. Harrison, Lloyds (Burton), Limited, Burton-on-Trent.
B. H. Kemp, Wharton Crane & Hoist Company, Limited, Stockport.
M. K. Milner, Keighley Laboratories, Keighley, Yorks.
G. Perkins, Catton & Company, Limited, Leeds.
K. E. Porter, Sterling Metals, Limited.
D. Powell, Henry Wallwork & Company, Limited, Manchester.
W. Simons, Thomas Broadbent & Sons, Limited, Huddersfield.
E. C. Sykes, Bamforth, Garside & Company, Linthwaite, Huddersfield.
D. H. Wilkinson, Keighley Laboratories.

LONG-SERVICE AWARDS have been presented to 316 employees of the metals division of Imperial Chemical Industries, Limited, at a works dinner held at Witton, Birmingham.

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Mining Machinery for Canada

An aggressive export policy was needed by British firms making mining machinery to sell more equipment to Canada's metal-mining industry, said Mr. M. Boyer, Deputy Minister of the Canadian Department of Mines. Mr. Boyer, who is a member of a three-man mission representing the Canadian mining industry which is visiting Britain at the invitation of the Dollar Exports Council, said in a speech in London that Canada's mineral industry was second in importance only to agriculture in the economy. There were at present more than 200 mines operating in Canada, and the industry was steadily expanding.

Most of the machinery for Canada's mining industry was imported, Mr. Boyer continued, purchases from outside Canada in 1953 being worth at least $35,000,000. But between 85 and 90 per cent. of the imported equipment was currently bought in the US and only 6 per cent. was supplied by the UK. British-made mining machinery, he believed, was at least equal in quality to American and at the present time the British manufacturer had a price advantage of 10 to 20 per cent. over his American competitor due to lower labour costs.

Delivery dates, which in the past had operated against the UK manufacturer, were now nearer those offered by the American makers for most types of equipment. American and Canadian manufacturers had served Canada's mining industry well in the past, however. If British firms were to increase their share in the market they would have to break through American and Canadian competition.

Mr. Boyer called for more active efforts by British manufacturers to sell mining machinery in Canada. He suggested that more principals from British companies should travel to Canada and visit the mining areas to understand requirements.

Furnace Conditions Shown by Models

Introducing a discussion on "Heat Losses Through Furnace Structures," at a meeting of the North Staffordshire Fuel Society at Stoke-on-Trent, Mr. E. W. Voice, head of the iron-making division of the British Iron and Steel Research Association and former assistant director of the Mining Research Establishment of the National Coal Board at Isleworth (Middx), showed how small models could be used to simulate, in a few hours, some of the conditions occurring in blast furnaces after they had been in operation for several months. He also showed how two-dimensional electrical systems could be built up to answer problems which arose in furnace design.

After discussing relationships between temperature gradient and heat flow and simple inferences that were independent of the size of the furnace, Mr. Voice described the models and technique used to show how heat transfer affected metal penetration in blast-furnace hearths. Earlier attempts to reduce wear on carbon hearths by using large keyed blocks, flat beams, and corrugated blocks, had not been successful, because the problem was essentially one of temperature gradient.

A low-temperature gradient allowed liquid metal to penetrate to a considerable depth and since a penetration of 2 ft. provided flotation forces of about 800 lb. per sq. ft., it was clearly difficult to provide bonding that would resist these forces. The models showed the depths of penetration to be expected under different conditions, and indicated that if thick firebrick insulation had to be used the hearth should be built of long carbon blocks set vertically to obtain a more durable structure.

Hungary's New Iron Foundry

What will be Hungary's largest iron foundry is taking shape on a 40-acre site at Soroksár, on the southern outskirts of Budapest. The Hungarian Metallurgical and Machine Industry Ministry ordered the construction of the works in 1951, and in January this year the first tapping of grey iron was made from the cupola furnace. So far, £1,400,000 has been spent on building the plant, which is due to be completed by 1960.

The main building completed is 440-ft. long and 375-ft. wide, fitted with 11 travelling cranes of between 1.5 and 20 tons capacity. There are four cupola furnaces (Fig. 1), each with three rows of tuyeres. All processes are fully mechanized; the factory is centrally heated and is linked with the administrative block by covered corridor. Showers and washrooms for 600 workers have been fitted up.

FIG. 1.—*Tapping a cupola at the new Soroksár Foundry, Hungary.*

British Cast Iron Research Association

Annual Report for Year ending June 30, 1955

At the annual general meeting of the Association held in London on November 3, 1954, Mr. S. H. Russell was elected president of the Association in succession to Sir Frederick Scopes. Mr. J. Bell, Mr. S. W. Martin and Sir Harold West were elected members of Council and vice-presidents. Mr. C. C. Booth, Mr. A. E. Pearce and Mr. J. J. Sheehan (already members of Council) were elected vice-presidents. Sir Frederick Scopes, the retiring president, and Mr. C. A. Spencer (formerly of the Department of Scientific and Industrial Research) were elected honorary members of the Association.

During the year, the Council, under the chairmanship of Mr. J. J. Sheehan, held six meetings, and the advisory committee held ten meetings. Fifteen meetings in all were held by the main committees of the Council (Research Board and Research Committee, chairman Mr. A. E. Peace; Development, chairman Mr. J. J. Sheehan; Information, chairman Mr. R. L. Handley; Operational Research Team, chairman Mr. A. Watson*; Foundry Atmospheres, chairman Mr. C. Gresty; and Scottish Committee, chairman Mr. J. Arnott). Fifteen meetings were held by the research sub-committees and panels, making a total of 46 meetings in all for the period.

New Quinquennium

The last report explained the terms of the offer from the Department of Scientific and Industrial Research, accepted by the Council, for the five-year period beginning July 1, 1954. The Department undertook to maintain an annual block grant of £40,000 for a minimum industrial contribution of £100,000, together with a supplementary grant up to a maximum of £16,000 in return for further industrial contribution up to £20,000. The Association expresses its grateful indebtedness to the industry which, through the Joint Iron Council and its constituent bodies, the Council of Iron Producers and the Council of Ironfoundry Associations, made the necessary provision for the increased funds required. Before the end of the year under review it became clear that the industrial contribution required to secure the maximum grant would be forthcoming, with the result that the total income for the year reached the record figure of over £190,000 of which the amount received under Conditional Aid was £7,780. This latter source of income will be exhausted at the end of 1956.

There is need for a measure of expansion for the general research and development activities and it is intended to provide a new research block which will house the whole of the experimental research activities at a total cost in building and equipment of some £50,000. This will include those laboratory activities which, since the removal to Bordesley Hall, have been carried out in the original premises, and the space vacated will in due course be fully occupied by the Intelligence Department and library, office and administrative activities.

When the application was made to DSIR stress was laid on two major proposals, to some extent interconnected. The first of these relates to the problem of phosphorus in cast iron. The demand for low-phosphorus and hematite irons tends to increase. It is well known that while the bulk of phosphoric pig-iron used in the industry is largely based on home iron-ore resources, which are still very substantial, hematite and low-phosphorus pig-irons are made from imported ores, only a small and diminishing proportion being derived from home resources. Apart from its obviously important strategic aspect, there are considerable technical repercussions. It is therefore highly desirable that the Association should explore the technical possibilities of reducing the phosphorus content of native pig-irons without loss of carbon, such as takes place in the basic Bessemer process. In order to prepare a suitable programme the Research Board has set up a phosphorus panel with Mr. E. Morgan as chairman, and containing representatives of member-firms and authorities with special knowledge and experience in this field. Certain aspects of the problem of sulphur in cast iron will also be considered.

The second major proposal referred to furnace research, equipment for which will in any case be required for the work on phosphorus. A building for use as a melting research station had already been completed at the time of the DSIR application and pending the receipt of equipment has been temporarily used for work on foundry atmospheres. It is proposed to instal equipment to provide the whole of the molten metal required for the research and development programme. To it will be transferred the crucible furnaces now in use, together with the vacuum melting furnace referred to elsewhere, and a high-frequency melting furnace. In addition, space is provided for a cupola melting furnace which will be designed and arranged to permit experimental work on the design and operation of this type of furnace, both for cold blast and hot blast, and providing for work on oxygen enrichment, cooling of the melting zone, basic and neutral linings, and improved instrumentation. In addition to the work on phosphorus, this equipment will be closely linked with other experimental work now proceeding or pending on gases, nucleation, slag-metal reactions and oxidation and deoxidation phenomena.

The work carried out during the year is dealt with departmentally. The Council wishes gratefully to acknowledge gifts of equipment assisting the

* While this annual report was in the Press, the Council learned with deep regret of the sudden death of Mr. A. Watson, assistant managing director of the Stanton Ironworks Company, Limited, who served as a member of Council for a number of years and was chairman of the Operational Research Team Committee from its inception.

British Cast Iron Research Association

work of the Sands Laboratory from Ridsdale & Company, Limited, Middlesbrough, and the Fordath Engineering Company, Limited, West Bromwich. Announcements have also appeared in the press of a gift to the Association of a vacuum melting furnace, marked by a ceremony at Boston, Massachusetts. This particular furnace was the hundredth of its type made by the company concerned and was provided through the Foreign Operations Administration* on the order of the Department of Scientific and Industrial Research.

The furnace was handed over by the president of the National Research Corporation of Massachusetts, in the presence of the Governor of Massachusetts, Mr. C. A. Herter, who presented a commemorative plaque to Mr. W. Barker, the British Consul-General in Boston. This plaque has since been received by the DSIR and in due course will be attached to the furnace, the receipt and use of which, however, still remains dependent on the result of negotiations with the Board of Trade on the question of import duty.

Research Department

Soundness of Iron Castings

The results of preliminary work on the influence of melting and pouring temperatures, inoculation, moulding practice, and design variables upon sinking under bosses in thin plates have been reported. This subject is of considerable importance to the manufacturers of light castings for domestic purposes which require to be enamelled. Fundamental studies of solidification sequences have continued. Thermal analyses have been performed upon test-pieces to study the effects of pouring temperature, silicon content, and inoculation, and the results are being interpreted by microscopic methods. A preliminary account of this work has appeared.

A study has been initiated of keel-type test blocks suitable for nodular cast iron. Blocks have been subjected to detailed microscopic and mechanical examination to obtain information on porosity distribution. The influence of oxygen content on shrinkage defects has been studied; wide variations in oxygen content have failed to alter shrinkage characteristics of K-bars cast in grey irons of varying phosphorus content and in blackheart and whiteheart malleable irons. In connection with the influence of moulding materials on soundness, the use of CO_2 Process moulds has been studied and they have been shown to compare favourably with dry-sand methods. The influence of melting and pouring temperature on the porosity of K-bars cast from uninoculated irons of varying carbon and phosphorus contents has been studied, and this work continues.

An investigation has been carried out on surface pinholing in nodular iron castings. An examination of pinholing in ordinary grey-iron castings has shown that pinholing can be produced by small additions of aluminium to molten metal. The severity of the defect varies with the section thickness of the casting and the amount of aluminium. Detailed field studies are in progress to investigate the cause and possible cures of drawing in light section castings. Data over a period of 18 months have been collected from one foundry and are being subjected to exhaustive statistical examination. Important results have been obtained and a report is in preparation.

Gases in Cast Iron

Work on the partitioning of nitrogen between elements such as aluminium and titanium, etc., and iron, has been completed. This involves the measurement of the acid insoluble and the acid soluble fractions during the chemical determination of nitrogen. The neutralization of the effects of nitrogen by aluminium and titanium are shown to take place by the formation of acid insoluble nitrides. However, the nitrogen neutralizing effect of boron appears to be more complicated. The results of this work have been published.

A technique has been developed for the estimation of hydrogen in cast iron, using vacuum heating. The evolution of hydrogen from cast iron at temperatures between about 20 deg. C. and 1,150 deg. C. has been studied and it has been shown that the vacuum-heating technique can be applied to the determination of hydrogen in white cast irons. Apparatus has been developed to measure both the rate of evolution and the total volume of hydrogen. Considerable work has been carried out on the sampling of molten metal for hydrogen estimation and a technique of using "sucked" samples has been developed which appears very promising. The influence of hydrogen on chilling tendency, structure and soundness has been studied. Further work has been carried out on the influence of oxygen on chilling tendency. Much of the work on gases in cast iron has been summarized in a paper presented at the International Foundry Congress in London, 1955. The influence of hydrogen content on the soundness of austenitic irons has also been studied.

Sands

A high-frequency apparatus for the rapid heating of sand test-pieces, enabling them to be tested mechanically at elevated temperatures, has been completed and the work on this subject has made considerable progress. A general account of the results has been published.

A report has been published on the results of an investigation into the effect of dead clay on the properties of moulding sand. Excessive build-up of dead clay can be detected by means of routine tests for moisture content, green strength and shatter index. Methods of controlling dead clay and neutralizing its effects have been indicated.

Work is proceeding on methods for the rapid estimation of moisture content in sand samples and a preliminary report is available on a method of obtaining the moisture content of sand by measuring its capacitance. This method is influenced by

* Now International Co-operation Administration.

the packing density, but is not affected by small changes in amounts of coal dust, clay or tramp iron, or by the thickness of the layer of sand. Work continues with the object of obtaining continuous records of the moisture content of a stream of sand in a mechanized plant, to supplement laboratory estimations of moisture content.

The courses on sands continue to receive considerable support from member-firms, who nominate representatives to take the four-day course. Groups of 12 students receive instruction. To July, 1955, 26 such courses have been held, with a total attendance of 292.

Corrosion

Field tests are still in progress on the application of cathodic protection to cast-iron ship propellers with special reference to the prolongation of anode life. Protection by heavy-duty coatings in conjunction with cathodic protection has also been studied. Surveys and records of buried cast-iron pipe lines continue and the effectiveness of cathodic protection to these is under observation. Throughout the year many and various *ad hoc* corrosion problems have been dealt with.

Methods of Analysis

Work has been pursued in co-operation with other laboratories on improvements in routine chemical analysis. Reports have appeared on the sampling of nodular cast irons for carbon determination and on the determination of phosphorus. A rapid method for the determination of magnesium in cast iron has been developed and successfully used in a number of members' laboratories. Considerable improvements have been made in the speed of methods for the analysis of slags. The time required has been reduced by about 25 to 30 per cent. A method for the rapid determination of pitch in moulding sands has also been developed.

The experimental work of the spectrographic section has been entirely concerned with the application of spectrographic methods to the analysis of slags. This work is continuing. In addition, the equipment has been used for a record number of estimations for the research and development programme.

Malleable Cast Irons

Much work has been done on the production of sound test-bars for malleable cast iron. An analysis has been made of the reproducibility of properties in various malleable iron foundries using several methods of running and feeding test-bars. This work is in progress. Further work has been done on the influence of graphitization on rate of decarburization. Some work has been begun on the influence of atmosphere composition on the penetration of sulphur during the annealing operation.

Mechanical Properties

Work on the influence of surface rolling on the fatigue properties of flake- and nodular-graphite cast irons has been published. A considerable programme of work on the influence of under-stressing and over-stressing on the fatigue properties of nodular cast irons is approaching completion. The stress/strain curve in tension for nodular cast irons has been studied and a report issued. Work on the influence of annealing temperature on the ductility and brittleness of ferritic nodular cast irons has shown that annealing below the critical range causes embrittlement.

An extensive investigation of the influence of trace elements on the high-temperature properties of pearlitic nodular cast iron has shown that various trace elements have found a profound effect on mechanical properties at temperatures of 400 to 600 deg. C.

A programme of fatigue tests on hardened and tempered nodular irons has been completed and the results have been published.

Data are being collected on the use of cast iron in steam engineering, with the object of encouraging the use of cast iron at temperatures in excess of the present limit of 230 deg. C. This investigation was begun following a meeting organized by the Association in London on December 15, 1954, of representatives of castings manufacturers, inspecting bodies, the British Standards Institution, and public authorities.

Enamelling

Work on the evolution of gases during the enamelling cycle by heating samples in a stream of purified argon and analysing the gases evolved by means of an infra-red gas analyser has shown that the gases evolved increase with storing time before treatment, and also with annealing. Many *ad hoc* enamelling problems have been dealt with.

Heat Resistance

A programme of work on the influence of aluminium in irons of various silicon and chromium contents has been completed and will be reported shortly.

Solidification of Cast Irons

Further experiments have been carried out to obtain information on the mechanism of formation of under-cooled graphite in cast irons, and also on the decomposition of iron carbide shortly after solidification.

Development Department

The number of enquiries received by the Development Department, including routine estimations, amount to approximately six problems per working day. Of these, approximately four are major problems, involving investigation, and in many cases a visit to the plant concerned. Approximately 335 visits have been paid to foundries in the course of the last twelve months by various members of the Development staff.

Arising from certain problems submitted, investigations have been put in hand and completed on the strength and machinability of welds in cast iron; brittleness in bronze welds; wear of machine tool slides, shears and guideways; melting practice; and the use of fuel for various foundry purposes. Other

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problems have required work on the heat-treatment of cast iron, the use of cast iron for forging dies and brake drums, and the use of heat-resisting irons as a substitute for refractories for the lower-temperature end of continuous furnaces.

The service dealing with the use of fuel in the foundry, financed by funds received under Conditional Aid, has been continued, and the volume of work carried out remains undiminished. A large number of visits have been paid at the request of member-firms, particularly in relation to melting practice. Under the same scheme, the member of staff engaged to deal with the running and gating of castings has also been kept fully occupied with these foundry problems.

Foundry Atmospheres Team

The Foundry Atmospheres Team has been particularly active, and a very large programme of work to establish the air movement and velocities required to control dust with various types of knock-out has been completed. Subsidiary investigations essential to the progress of this work included the evaluation of the effect of thermal currents, the formation and dispersal of dust within a foundry, and the control of dust at points other than the knock-out. The ventilation of a small, unmechanized foundry was examined by the Building Research Station and the Foundry Atmospheres Team some time previously, and this work has now been prepared for publication. All the work mentioned, together with other papers dealing with the control of dust in fettling, grinding and other operations, was presented at a conference held at Harrogate in April, 1955, which was timed to present the latest results of research in such a manner that they could be applied before the introduction of the section on dust and fume of the Iron and Steel Foundries Regulations in January, 1956.

The problem of external air-pollution is also assuming considerable importance, and one section of the Foundry Atmospheres Team has been repeatedly called upon to advise on the arrest of dust from cupolas, as well as the general control of dust in the foundry, particularly from the fettling sections.

Scottish Laboratories

Enquiries to the Scottish laboratories are included in the figures given above. The laboratories continue to function with reduced staff, but it is hoped that this position will be corrected in the very near future. The Scottish Council (Development and Industry) has launched a technical service bureau for the purpose of distributing technical information among small and medium Scottish firms. The laboratories are co-operating as required, and already a considerable number of enquiries have been dealt with as a result.

Operational Research Team

The Operational Research Team continues to deal with layout and production problems, and the Team now also includes a member of staff appointed under Conditional Aid to advise principally on the use of the sandslinger and the possibility of substituting green-sand for dry-sand moulding. In general, the firms visited are taking full advantage of the advice given and in many cases they are adopting suggestions that have been made. This has led to a rather larger number of return visits during the year.

Unfortunately, the leader of the Team, Mr. J. Hunter, has been seriously ill for some months, but in spite of this 105 visits have been paid during the year (of which 37 were return visits at the request of the foundries concerned), thus bringing the total number of visits made since the inception of the team in June, 1950, to more than 600. Consequent on these visits, some 333 foundries have been furnished with a report giving a complete survey of the whole of their production; the remaining visits were concerned with special items or sections of the production, or represent return visits arising out of the recommendations made by the team during its first visit.

As a result of visits to over 240 foundries, statistical data have been prepared and published dealing with the output of castings in various sections of the industry, the allocation of labour to various foundry processes, and methods of production according to the product. This is the first detailed survey of its type to be published and will prove of great value to the individual ironfounder in assessing his productive position in relation to the rest of the industry.

Intelligence Department

Publications

During the period under review, the BCIRA *Journal of Research and Development* completed its fifth volume, and 22 reports have been published in the year. The BCIRA *Bulletin* has now completed its twelfth volume and a number of reviews have appeared: on the machinability and machining of cast iron, the use of plaster patterns, and the Sulfinuz process. Fifteen external reports have been issued, including 11 by members of the staff which have been published by various external organizations and in technical journals. In addition to these reports, 18 lectures were given by members of the staff to various technical bodies.

Publications prepared additional to the *Journal* and *Bulletin* include a booklet describing the status and work of the Association (BCIRA *Services to the Ironfounding Industry*) and the *Proceedings* of the Harrogate conference. This latter publication, which will form a volume of some size, will appear towards the end of the autumn.

Enquiries

The enquiries received by the Department show an increase on the previous year. Library loans to members (excluding technical enquiries) were 1,283 in the period under review. Since this figure represents only 30 per cent. of the total loans for the year (the remainder being borrowed by the internal staff), it is plain that many more member-firms could make use of these services than do.

Exhibitions

During the year, the Association has contributed exhibits to the centenary exhibition of the Birmingham and Midland Institute in January, 1955, to a stand organized by the Department of Scientific and Industrial Research at the British Industries Fair, Castle Bromwich, in May, 1955, and to the Society of Chemical Industry's historical exhibition at Birmingham University at the beginning of July.

Conferences

Two conferences have been held during the year. The first, a research conference, was held at Ashorne Hill in November, 1954, to consider the present and future work of the Research Department. The second conference was on foundry ventilation and dust control and was held at Harrogate in April, 1955. The attendance (excluding staff) at this second conference reached a record figure of 252. It was attended not only by a considerable proportion of members, but also by representatives of manufacturers of ventilating equipment, trade unions and Government departments. Much fundamental work was presented and the published proceedings will form an authoritative basis of information, both for the founder and the designers of ventilating and exhaust equipment.

Visits to Headquarters

Six organized parties have paid visits to the Association's headquarters at Alvechurch. These have comprised apprentices from member-firms, senior students from schools and technical colleges, the Joint Standing Committee on Conditions in Iron-foundries, and the Fox Club, named after the late E. J. Fox, its founder. In addition, there have been many visits, too numerous to mention, paid by representatives of member-firms and of foreign and overseas firms and organizations.

The total membership of the Association in all classes at June 30, 1955, was 1,337.

The Report is signed by Mr. S. H. Russell, the president; Mr. J. J. Sheehan, the chairman of Council, and Dr. J. G. Pearce, the director.

Book Reviews

Form Design—Report from the Office Management Association, 58, Victoria Street, London, S.W.1; price 6s.

Most people dislike filling in or (as the Americans say) filling out forms, particularly those which require a signature and are apparently made of poor-grade blotting paper, and it is this instinctive antipathy which makes the reviewer welcome the publication of a booklet entirely devoted to the design of good, understandable and useful forms. In a mere 23 pages, plus appendices, the whole business of designing forms upon which the desired information can reasonably be entered and subsequently made use of, has been admirably dealt with.

The reviewer, who has some knowledge of form design and machinery accountancy, found no mention of numbering positions on forms so that they can be economically referred to in written instructions, and he failed to understand the reference under the sub-heading: "Punched Cards" to producing small copies "side-by-side rather than through carbons," but this might be something which is possible with one particular punched-card system.

For the rest, the book is readily understandable and is capable of being remarkably useful. Since any form which is completed in working hours must cost more to fill up than it does to produce, it seems clear that this book should be in the hands of all who have to do with the "getting out" of forms in foundries and factories.

H. J. B.

"Dust is Dangerous," by C. N. Davies, D.Sc. Published by Faber and Faber Limited, 24, Russell Square, London, W.C.1; price 21s. net.

Written for the general reader by a specialist in the subject, the book offers a wide range of information in an eminently readable form. It does not deal with the particular problems that beset the foundryman, but there can be no doubt that anyone who has to control, or live in, a dusty atmosphere would profit by reading this volume. Readers of the JOURNAL will be well acquainted with the efforts that have been and are being made to suppress dust in foundries. Dr. Davies's book now fills in a background of fundamental knowledge against which foundrymen, who may have little specialized information on the subject, will be able to judge those efforts and make their own contribution to the problem.

The book describes many hazards produced by many different kinds of atmospheric pollution in many industries. It then discusses dust-sampling methods in a way that should help general readers to an appreciation of the difficulties of interpreting the results of dust determinations. A chapter is devoted to preventive measures and here again the fundamental conceptions underlying these measures are discussed so that a proper choice of particular methods can be made in individual circumstances.

Separate chapters are also devoted to radioactive dusts, house and non-industrial dusts and dust explosions. The whole book provides a good general introduction to a diverse subject from which foundrymen, and others in particular industries, can move to a study of special problems, either through the papers given in the list of references or through their own research and development projects.

Guide Pratique de Conduite des Cubilots pour la fusion de Fonte Grise (Practical guide to cupola operation when melting grey iron). Published by *Editions Techniques des Industries de la Fonderie*, 12, Avenue Raphaël, Paris 16; price 450 French francs.

This 24-page booklet has obviously been prepared for use by the men on the shop floor, as it gives very precise instructions how to run a cupola from lighting up to the "drop" at the end of the blow. It is illustrated by a series of humorous pictures, in which the furnace is usually quite human. The cupola taken as standard is of a type very different from what is normal here. The blast pipe is high up, whilst twin tuyeres are usually shown.

There are so many methods of "killing cats" that even the good advice given as to the separation of charges should not be taken as the last word on the subject. Well-conducted wedge tests can permit of the use of simpler methods than those detailed. In general the precepts enunciated are sensible and if followed will facilitate the proper operation of the furnace. V.C.F.

Notes from the Branches

Tees-side

At the first meeting of the 1955/56 season of the Tees-side branch of the Institute of British Foundrymen on Friday, October 14, there was a record attendance. It was opened by this year's president, Mr. Frank Shepherd, who welcomed the large audience, and made particular mention of a party which had travelled by 'bus from Wolsingham to attend the meeting. He said he felt that there was a combination of reasons for the very large meeting, the enthusiasm always shown at the beginning of a new season, the interest of the members in the lecture, and possibly, he hoped, a desire to support a new president. The lecture, extensively illustrated with slides, was given by Dr. D. V. Atterton and was entitled the CO_2 Process. It was evident there was great interest in this modern method, most foundrymen on Tees-side had evidently experimented on a small scale with the Process and some, it appeared, were using it as a part of routine production.

On completion of the lecture, Dr. Atterton was subjected to a battery of questions with which he was well able to deal. It was evident that founders in the area were aware of the possibilities arising from the use of CO_2 in the preparation of moulds and the saving of time and increased production due to the fact that cores no longer required stoving. There were, however, limits to the applications for which the Process could be used.

MR. A. P. RILEY, senior vice-president, proposed a vote of thanks to the lecturer and expressed the hope that one day CO_2 might be used in the production of castings of the extremely heavy type, produced by his company.

The branch's next function will be the Social Evening at which Dr. Everest, the national president of the Institute, will be present. This is to be on Friday, November 11, in Head, Wrightson's Teesdale Hall at Thornaby-on-Tees. A large attendance is expected on this occasion, when many members will support the branch president who has been for so long the branch secretary.

Bristol and West of England

The Bristol and West of England branch, recently the host for "National Works Visits Day," had a full and successful programme on October 22. In the morning, by kind permission of the Bristol Education Authority, a meeting for foundry and pattern-making apprentices was held at the Bristol College of Technology. Seventy-two apprentices enjoyed a film show, in which the following were exhibited. "Cupola Operation;" "Moulding with a Loose Pattern;" and "One Off or a Million Off." Following the meeting, the apprentices were entertained to luncheon by the branch Council. Addressing the assembly, Mr. D. A. Richards, president, said that the Council was pleased to see the excellent response to the proposal to hold such a meeting, and although it was of an experimental nature, it was hoped that many more would follow.

The second meeting of the day was held at the Grand Hotel, Bristol, when members enjoyed Papers by Mr. H. Haynes and Mr. C. R. Van der Ben. In presenting his Paper, on modern green-sand moulding, Mr. Haynes said that castings of components weighing up to 18 tons, often made in dry sand, could be equally well made in green-sand if the castings were treated according to their merits, and commonsense and courage were used in planning their production in the foundry. Illustrating his Paper by means of slides, Mr. Haynes showed how such castings were being made with a consistently high standard of finished product. Dealing with the production of high-duty cast irons, Mr. Van der Ben referred to the amazing development in these irons in recent years, saying that properties now being called for daily were not even visualized 20 years ago. The introduction of acicular s.-g. irons had meant that the mechanical properties of cast irons had been increased by 100 per cent. in a relatively short time. The addition of comparatively small amounts of molybdenum, or of molybdenum and nickel, to cast irons having a base composition of carbon 3.26, silicon 1.39, manganese 0.8 per cent. would increase the mechanical properties by approximately 50 per cent., and by careful adjustment of alloy additions even higher increases could be obtained. High-duty cast irons were often being employed now for items which were previously made from forgings.

Discussion

Replying to the many questions which the papers evoked, MR. HAYNES made the following points:— Small additions of lime to the moulding sands used for these heavy castings had been found beneficial in giving increased hot-strength. For castings moulded in the foundry floor, no great advantage was to be gained by the use of impeller rammers, but these were of considerable use when large moulding boxes were employed. The metal for these heavy castings could always be poured as hot as possible without any detrimental effects. The washing of moulds with a weak salt-solution was often found to give excellent "keying" surfaces for subsequent blacking operations.

MR. VAN DER BEN, replying to questions on the metallurgical aspects of the papers, said that nickel was generally to be preferred to copper for making alloy additions. The use of molybdenum and nickel together, where the amount of nickel was approximately twice that of the molybdenum, would give comparable results to a higher addition of molybdenum alone. In order to ensure the maximum properties from acicular irons, it had been found that a maximum phosphorus content of 0.09 per cent. was desirable.

In proposing a vote of thanks, MR. H. V. HEATH, the past-president of the branch, said that the speakers had by now become almost a regular feature of the winter sessions, but that was because their papers were always very welcome, being of a practical nature, and containing sound advice. It was usual experience that Mr. Haynes and Mr. Van der Ben would throw new light on subjects so often considered to be major problems by so many foundrymen. Furthermore, the speakers were always willing to give freely of their experience, and never appeared to tire of the many questions put to them.

The vote of thanks was seconded by MR. D. P. WILLIAMS, senior vice-president, who agreed with Mr. Heath that the afternoon's Papers had brought a new light and a breath of fresh air to some of the problems with which many founders were confronted.

THE WIDESPREAD industrial prosperity of the region was referred to at a meeting of the London and South Eastern Regional Board for Industry on November 2. Mr. Barry Kay, Regional Controller of the Board of Trade and Ministry of Supply, said that with order-books full, production was, if anything, increasing. Delivery times were generally improving and delivery dates being advanced, particularly for overseas buyers. The total number of persons employed in manufacturing industry in the region at the end of August was 4,160,000.

Quality Control in a Large Foundry in the Automotive Industry*

Discussion of the Congress Paper by R. Baggio

Members' comments mainly concerned points of detail in the scheme of control which the Author described in his Paper. In this respect, such matters as the "life" of bentonite clays; methods of reporting defective castings; mould hardness estimation; malleable-iron testing; furnaces, and temperature measurement were typical of the subject matter. Other contributions compared the Author's methods with those applied elsewhere and were generally of a congratulatory nature, more than one speaker saying that an extension of this sort of control in foundries was desirable.

The Italian Exchange Paper presented to the International Foundry Congress last June, on "Quality Control in a Large Foundry in the Automotive Industry," was presented in person by the Author, who is attached to the Fiat foundry in Turin and who spoke in French. Mr. C. Chiabotti acted as interpreter; Mr. H. J. V. Williams, senior vice-president of the Institute of British Foundrymen, was in the chair.

Opening the discussion, Dr. J. WHITE said he was particularly interested in Fig. 9 which dealt with what Mr. Baggio called "ageing" tests. These were apparently very similar to the "life" tests described in the Paper by Mr. Middleton and himself and he would like to know whether the Author had found the life test of great use as an aid to control in the foundry. Regarding bentonite "B" which was reported to give an increase in green-strength with repeated heating; he and his colleagues had tested a number of bentonites by their method and so far they had not found one for which the green-strength increased. He assumed that no fresh bentonite was added during the test, but possibly he might be wrong there.

Replying through the interpreter, Mr. Baggio said the bentonite was a type which was in common use at Fiats but which only once had given that strange behaviour—it has been an exceptional case. Normally this particular bentonite showed green-strength decreasing, but more slowly than other types.

Bentonite Tests

DR. WHITE said that he had not so far found a bentonite which behaved in that manner and gave an increasing strength after heating, but what he would really like to know was—did the test prove to be of great use and did it correlate with performance of the sand in the foundry?

Replying, the INTERPRETER stated that the tests were carried out during the production run on each shipment of bentonite received.

DR. WHITE explained what he wanted to know was if, when a bad sample was found on test, it was equally faulty in the foundry.

The INTERPRETER replied that the tests described were used on every shipment and gave an idea of the properties of that material. There might be variations with each consignment, testing in this way gave an idea of the average qualities and properties. Summing up, it had been found that when a certain type of bentonite gave a bad "ageing" result, its use in the foundry necessitated greater additions to maintain the correct green-strength. Furthermore, the used sand accumulated a greater quantity of dead bentonite.

DR. C. J. DADSWELL asked if the results in the foundry, namely, the castings, followed the trend which the "life" tests indicated. If the tests indicated a fall in quality did the castings follow suit?

The INTERPRETER said that in a continuously working plant like that of Fiat's, one quality of bentonite would do its job for a longer time than another. If they had pure bentonite, its bonding power in the sand would be indicated by the tests and from Fiat's point of view it was very important to estimate its life. In order to bring a poor bentonite, with a weak bonding power, up to the level of the standard, additions had to be made to control the undesirable factors.

Correlating Casting Quality

Dr. Martin thought the Paper contained a great deal of information on detail quality testing, but what was important in a foundry was not so much to produce perfect sand or cores, but to produce good castings. The only way in which variables could be tied to the quality of the casting was to correlate casting quality with the tests. In the Paper, no information was given of the statistical analysis of casting defects. He would be interested to hear if the Fiat concern did carry out a detailed analysis of defects or scrap.

THE INTERPRETER replied for Mr. Baggio and said Fiat's investigated the origin of casting defects by their own method and isolated the reason for any particular defect which appeared.

Continuing, DR. MARTIN said there was a method of correlating casting defects and raw materials which in effect constituted a method of operational research. It had been applied in the United States and to some extent here, in certain plants. When

* Paper printed in the JOURNAL, September 1, 1955

defects were encountered which were not readily explainable, by having a continuous correlation of the occurrence of such defects with the various properties of the raw material, such as sand strength, iron analysis, etc., it was possible to say immediately to what extent changes in those properties had had any influence on the defect, and to draw up specification limits of those properties which were directly related to casting quality. Had operational research been applied in Italy in general and in the Fiat foundry in particular?

THE INTERPRETER said, following British and American methods, a continuous record was kept of all variables which made it possible to refer back to any combination of materials and defects and find a reason. Every day of the year previous to and following the appearance of a new defect, they could investigate and discover the origin of it and the correlation of raw materials with its appearance. Very largely, the Fiat executives relied on the AFS booklet, "Foundry Defects," which they found of great help in tracing defects.

A MEMBER asked if operational research, in addition to statistical quality control, was applied in the Italian foundry.

THE INTERPRETER said the Italian executives had followed the development of the statistical quality control in America but in that country, in visiting foundries, had found that only in some sections of the die-castings industry was this method of control applied, and then to a limited extent. They themselves had done some operational research in conjunction with statistical quality control, but did not believe it would be practical in the Italian foundry at present, and were waiting to receive some more results from abroad. They would be very interested to know if the speaker had any experience in that direction.

Numbers or Weight

MR. A. J. SHORE said he thought that this was the sort of Paper which was well worth listening to because it had a practical aspect and there were a number of practical foundrymen present. He was particularly interested in the question of statistics which had been brought up, but he felt founders could go sometimes a little too far in that direction. It had to be borne in mind that foundrymen were in business to make good, saleable products—castings—and the Paper showed that the Fiat organization had that objective well in mind.

On the question of casting rejects, he asked if the percentage figures referred to numbers of castings or their weight.

MR. BAGGIO replied: Weight.

Continuing, MR. SHORE further asked if there was a check made from the point of view of number as well. It seemed to him that when a firm was operating in a very wide variety of components, number might be more useful than weight. Did Fiat use the same control methods at their Stabilimento Grandi Motori?

THE INTERPRETER replied that in actual practice various methods of recording scrap were employed, but because there was a space and time restriction in preparing a Paper only the weight method of recording had been included in it. The method described applied to the Fiat iron foundry which was customarily casting engine cylinder-blocks and not to the Grandi Motori Foundry, which was concerned with marine engines. The same sort of statistical methods were not used there because they were dealing with castings much larger in size but only required in comparatively small quantities.

Mould Hardness

MR. ARMITAGE said he was particularly interested to know that one of the "tools" which Mr. Baggio was using for regular control was measurement of the surface hardness of moulds. In the same paragraph of the Paper, he went on to say that on larger moulds he checked the hardness below the surface by means of a special instrument. He would be interested to know how much below the surface he took those measurements, and if the audience might have some details of the instrument used, because he felt that sub-surface tests could be quite important with the larger moulds.

THE INTERPRETER explained that the instrument used was a Durometer, an American production made in Detroit. Ramming hardness in the interior of the mould was checked with a special adaptation of their own of the instrument. It enabled them to check the stratification below the mould surface to see if it was correct. It enabled them also to check the ramming characteristics of the moulding sand and the hardness of different layers. Fiat executives had gone very carefully into that factor.

Malleable Testing

MR. F. G. GAILLY (from France) was interested in the malleable cast iron shown in Fig. 15 of the Paper which illustrated test-pieces for tensile strength, as commonly used, and also for dynamic bend-test and static bend-test. He would like to know if the bend test-pieces were made for each melt and how was correlation made with castings?

MR. BAGGIO replied that the tensile-strength and the static-bend test-pieces were cast for each melt. The dynamic bend-test was only done for personal investigation. As far as the static test was concerned, he had established that there was an optimum degree of angle which had to be maintained to ensure good quality in the firm's ferritic blackheart malleable.

Purpose of Pre-planning

MR. DENNIS O'CONNOR said he had been working in Italy for two or three years and was fairly familiar with what Mr. Baggio had done. He had had the pleasure of spending a few days with him to see what progress had been made and thought he was to be congratulated on the Paper presented.

On the question of the results developed with bentonite it came immediately to his mind that throughout the world it was found that the grades

of bentonite used and the results obtained might not be the same as those mentioned by the Author. As far as the work reported on was concerned, he pointed out that the tests which Mr. Baggio made corresponded with the difficulties he had experienced. He had in mind when he was developing that quality control to eliminate difficulties and make casting as practical as possible and to do away with any wasted effort and any possibility of defects before a casting was put into production.

As far as operational research was concerned, in Italy at the present time it was being studied in its relationship to the foundry industry. So far, it had been done in a big way and was not known as operational research. Its operation was being studied to reduce costs and difficulties of production.

He thought the Author was to be congratulated on having accomplished something which could be applied to every foundry with every metal. By applying such controls, founders would readily discover what was causing their difficulties and high costs and would be able to use the control to secure better results.

DR. DADSWELL said he had an important question to ask. At the end of the Paper, Mr. Baggio said that the total labour employed for quality control was 6.8 per cent. of the productive labour. He did not criticize that percentage, but asked whether that number included the people in the laboratory who did the tests, those on the floor of the shop who did the examining of the castings, and everyone involved in inspection.

THE INTERPRETER said it included everyone.

Congratulations

DR. DADSWELL, continuing, said the other matter he had to comment on was of a general nature, and was to say how excellent he thought the Paper was and how well worthwhile it had been to have it presented at the Congress, because, although there was nothing original in the idea behind it, the careful way in which it had been conducted in the Fiat works showed the right sort of thing which all managements should apply. Management to him was a question of logical thinking, and that meant logical control. There were examples: graphs were provided and one could find them done by someone or other in many places, but very seldom was the whole sequence of tests conducted regularly and then related with such thought as had been shown in the Paper, for which the Author deserved the thanks of foundrymen.

There were some people who said "Ah, yes, that is all right in a foundry on mass production." Although they were there making 200 different types of casting there would always be the man who would say: "In my foundry I make relatively large numbers of different types." However, he, the speaker, had always contended that one could still apply that same logical way of testing, whether a foundry was making a lot of different types or a great many of a very few types. The more one spent in that way the cheaper and the better castings would be.

MR. SHORE said he thought that what he and his colleagues had done on one job might be of interest. They had to cast weights, and the firm for whom he was working made a lot of them. They seemed to be a very simple casting, but had to be within a close range of accuracy and in consequence there was a very high percentage of scrap.

He had applied statistical control methods and drawn histograms of frequency variations and all that sort of thing. There were five patterns in a box and it was found that the histogram for one had a very peculiar shape while the others followed the normal curve. A square box was being used, which would take four patterns easily, but a fifth had been squeezed in. By means of a diagram, Mr. Shore then indicated the positions of the runners and showed that the fifth pattern was so placed as to receive the full force of the metal from the gate. When he bent the runner round so that the metal changed its direction of flow, so as to supply the fifth casting in the same manner as the other castings on the plate, the histogram for number five became normal.

The point he wished to make was that if founders examined what they were doing to start with, they would often not have to go through pages and pages of statistical data. However, it was an advantage to approach from a roundabout way sometimes, because this method occasionally uncovered something so simple that it was easily overlooked.

Important Details

MR. L. J. DUDDRIDGE said he had two points to make. First, on page seven of the preprint of the Paper, the Author had described the method of melting light alloys in an electric furnace. He would like to know whether that was a crucible-type of furnace using electric resistors in banks or whether it was an induction-type of furnace. Also he would like to know what was the metal loss on the average with that furnace.

THE INTERPRETER replied that it was an induction-type furnace and loss was 1 per cent. in the slag.

Continuing, MR. DUDDRIDGE said further down on the same page there was a reference to temperature control of pressure-die-casting dies. That was carried out by a thermocouple, but the mould temperature was controlled by means of a low-melting-point alloy.

Here, the INTERPRETER explained that both methods of control were used.

MR. DUDDRIDGE further asked if there was any special reason why they should use a low-melting-point alloy for checking the temperature of the mould, particularly when pressure-die-casting.

THE INTERPRETER said there was also used a thermocouple in contact with the steel die, especially with the more intricate and difficult types of dies. For more straightforward types of die the low-melting point alloy was employed.

Closing the session and thanking Mr. Baggio and the Interpreter for the most interesting discussion which they had made possible, the CHAIRMAN said there was one point in the Paper he would like to emphasize. It was that all foundries could benefit from the type of control described.

British Blast Furnaces in the Sept. Quarter, 1955

(These tables are published through the courtesy of the British Iron and Steel Federation.)

Derbyshire, Leicestershire, Notts, Northants, and Essex.

Name of firm.	In blast at end of the third quarter, 1955.					Weekly average in blast.	Total existing at end of quarter.
	Hematite.	Basic.	Foundry and forge.	Ferro-alloys.	Total.		
Clay Cross Co. (Iron & Foundries)	—	—	1	—	1	1	2
Ford Motor	—	—	—	—	—	—	1
Holwell Iron	—	1	2	—	3	3	4
Kettering Iron & Coal	—	—	1	—	1	1.8	2
New Cransley Iron & Steel	—	—	1	—	1	1	2
Renishaw Iron	—	—	2	—	2	1.7	3
Sheepbridge	—	1	1	—	2	2	2
Stanton Ironworks: Stanton-by-Dale	—	—	5	—	5	5	5
Staveley Iron & Chemical	—	—	4	—	4	3.5	4
Stewarts and Lloyds: Corby	—	4	—	—	4	3.9	4
Wellingboro' Iron	—	2	—	—	2	2	3
TOTAL	—	8	17	—	25	24.9	32

Lancashire (excl. N.-W. Coast), Denbighshire, Flintshire, and Cheshire.

Brymbo Steel	—	1	—	—	1	1	1
Darwen & Mostyn	—	—	—	1	1	1.4	2
Lancashire Steel Corp'n.	—	2	—	1	3	3	3
Summers, J.	—	1	—	—	1	1	1
TOTAL	—	4	—	2	6	6.4	7

North-West Coast.

Barrow Ironworks	3	—	—	—	3	2.8	4
Charcoal Iron	—	—	1	—	1	0.6	1
Millom & Askam	2	—	—	—	2	2	3
United Steel: Workington	2	—	—	—	2	2.4	3
TOTAL	7	—	1	—	8	7.8	11

Lincolnshire.

Appleby-Frodingham	—	4	—	—	4	4	6
Lysaght's Scunthorpe Works	—	3	—	—	3	3	3
Thomas, R., & Baldwins: Redbourn	—	3	—	—	3	3	3
TOTAL	—	10	—	—	10	10	12

North-East Coast.

Consett Iron	—	3	—	—	3	3	3
Dorman Long (Steel): Acklam	—	2	—	—	2	2	4
Redcar	—	2	—	—	2	2	2
Cleveland	—	2	—	—	2	2	4
Bessemer	—	2	—	—	2	2	3
South Bank	—	—	—	2	2	2	3
Gjers, Mills & Co.	2	—	—	—	2	2	5
Normanby Ironworks	2	—	—	—	2	2	3
Skinningrove Iron	—	1	—	—	1	1	3
South Durham Steel & Iron: West Hartlepool	—	2	—	—	2	2	2
Cargo Fleet	—	2	—	—	2	2	2
TOTAL	4	16	—	2	22	22	34

Scotland.

Bairds & Scottish Steel: Gartsherrie	1	1	1	—	3	3	5
Carron	—	—	1	—	1	1	4
Colvilles: Clyde Works	—	3	—	—	3	3	3
Dixon's	—	2	—	—	2	2	6
TOTAL	1	6	2	—	9	9	18

South Wales and Monmouthshire.

Briton Ferry Works	1	—	—	—	1	1	1
Guest Keen Iron & Steel: Cardiff	1	2	—	—	3	3	4
Thomas, R., & Baldwins: Ebbw Vale	—	3	—	—	3	2.6	3
Steel Company of Wales: Margam	—	3	—	—	3	3	3
TOTAL	2	8	—	—	10	9.6	11

Cost of Accidents in Industry

"Nearly 20,000,000 man-days are still lost every year through industrial injuries or through illnesses caused by occupational diseases. On any one day about 60,000 people are absent from work because of these things," declared Sir Walter Monckton, the Minister of Labour, at the opening of the London Industrial Accident Prevention Group's conference.

The Minister said that these figures gave some idea of the size of the problem, of the amount of human suffering involved, and of the losses inflicted on individuals. Much had already been done by legislation and through the voluntary efforts of industry, but there must be no let-up in efforts to ensure that machinery and working conditions were as free from hazard as it was possible for human skill, ingenuity, and forethought to make them.

Sir Walter stressed the responsibility of management in accident prevention and hoped for more trade union participation. As representatives of the men on the machine and the men on the shop floor, the unions could make a valuable contribution.

Sir Ewart Smith, chairman of the British Productivity Council and deputy chairman of Imperial Chemical Industries, Limited, said that the drive for safety precautions should always come from the most senior management, who should assume complete responsibility for eliminating accidents. Statistics were not available to determine the full cost of accidents at work, but it could be estimated that the total was likely to be much over £100,000,000 a year.

Nuclear Fuel Prospects

On the basis of present rates of growth of demand, at the end of the century the world seemed likely to require at least four to five times the present energy, said Sir John Cockcroft, director of the atomic research establishment at Harwell, in an address to the US National Industrial Conference in New York. The figure would grow from the equivalent of 1.8 billion tons of coal a year to six or seven billion tons, of which half would be used for generating electricity. Hydro-electric power could provide one billion tons of this. If most of the remaining electricity could be generated by nuclear energy, this would do the work of two to three billion tons of coal, leaving the need to increase coal and oil production by only one and a half billion tons. Even this might be hard enough, judging from British experience of coal production and the way that US oil production had levelled off.

Britain was in a rather special position, continued Sir John, with a rapidly increasing demand for energy, little hydro-electric power, and poor prospects of increasing coal production substantially. They were likely to require the equivalent of another 100,000,000 tons of energy by 1975. The Ministry of Fuel and Power and the Central Electricity Authority were planning to generate enough electricity from nuclear energy by 1975 to do the work of 40,000,000 tons of coal a year. Nuclear energy was essential for Britain—it would come only just in time.

Board Changes

LE GRAND, SUTCLIFF & GELL, LIMITED—Mr. J. F. Maher has retired from the board.

SHEEPBRIDGE COMPANY, LIMITED—Mr. Caryl H. Mostyn-Owen, who has been appointed a director, is also a director of the Staveley Iron & Chemical Company, Limited.

SPECIALLOID, LIMITED—Mr. T. O. Hunt, formerly technical and works director, has been appointed managing director of the company, and the subsidiary, the Aero Piston Ring Company, Limited, and has been appointed to the board of Specialloid (Sales), Limited. He fills the vacancies caused by the resignation of Mr. R. H. Hainsworth from the boards of the three companies. Mr. J. E. Freeman and Mr. F. R. Paterson have joined the board of Specialloid, the latter also joining the board of Aero Piston Ring.

British Blast Furnaces in the Sept. Quarter, 1955—continued

Staffordshire, Shropshire, Worcestershire, and Warwickshire.

Name of firm.	In blast at end of the third quarter, 1955.					Weekly average in blast.	Total existing at end of quarter.
	Hematite.	Basic.	Foundry and forge.	Ferro-alloys.	Total.		
Goldendale Iron	—	—	1	—	1	1	2
Lilleshall	—	—	1	—	1	1	2
Round Oak Steel Works	—	—	—	—	—	—	2
Shelton Iron, Steel & Coal	—	3	—	—	3	3	3
Stewarts and Lloyds: Bilston	—	2	—	—	2	2	4
TOTAL	—	5	2	—	7	7	13
Sheffield.							
Park Gate Iron & Steel	—	2	—	—	2	1.3	2
GRAND TOTAL	14	59	22	4	99	98	140

Weekly Average Number of Furnaces in Blast during the September Quarter, 1955, and the Previous Four Quarters

District.	1954.		1955.		
	Sept.	Dec.	March.	June.	Sept.
Derby, Leics., Notts., Northants, and Essex	24.2	25.8	26	26	24.9
Lancs. (excl. N.-W. Coast), Denbigh, Flint, and Ches.	4.2	5	6	5.8	6.4
Lincolnshire	9.3	9	9.9	10	10
North-East Coast	22.9	22	22	22	22
Scotland	9	9	9	9	9
Staffs., Shrops., Worcs., and Warwicks.	8.6	7.2	7	7	7
S. Wales and Monmouth	8.7	9	9 1	9.2	9.6
Sheffield	2	2	2	1.2	1.3
North-West Coast	7	7.6	7.9	7.7	7.8
TOTAL	95.9	96.6	98.9	97 9	98

The following companies have furnaces in course of construction or rebuilding:—John Summers; Dorman Long (Steel) (2); Lancashire Steel Corporation; South Durham Steel & Iron (West Hartlepool and Cargo Fleet); Steel Co. of Wales; Lysaght's Scunthorpe Works.

Industrial Output up in September

Preliminary figures indicate that the index of industrial production for September will be 138-139 (1948=100), representing an increase of approximately 4 per cent. over the figure of 133 for September last year. The provisional figure of 118-119 for August has now been corrected to 117. Output in both July and August was 3.5 per cent. higher than in the same months of 1954.

The rise in output over the first quarter of the year, at 6.1 per cent., was greater than in either of the two following quarters. The figures for the third quarter were particularly low, output showing an increase of 3.7 per cent. In the first three quarters combined, production was 5 per cent. higher than in the same period of last year. Output of manufacturing industry, however, rose by 7 per cent. during the first eight months of the year.

Lower production in the mines has adversely affected the all-industries index. Last year coal production was only 10 per cent. higher than in 1948 and this year may be only 8 per cent. higher. It is expected that the steel industry's target of 19,500,000 tons will now be achieved. Steel production over the first three quarters of the year was 7 per cent. higher than in the same period of 1954. Some of the metal-using industries, however, especially motor-car manufacturing, have been expanding at an even greater rate.

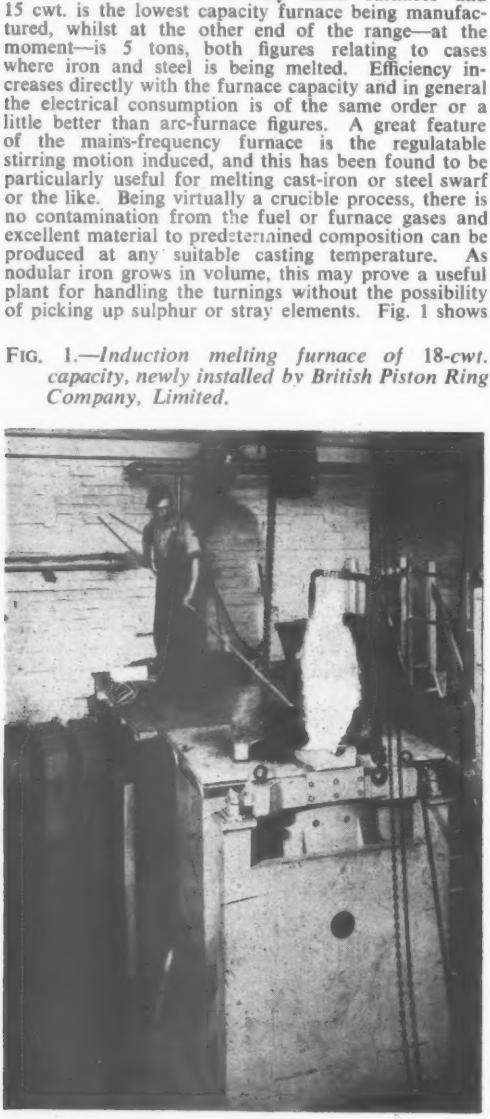
HORSELEY BRIDGE & THOMAS PIGGOTT, LIMITED—Cmdr. Colin Buist, RN (Ret.), has been appointed deputy chairman.

New Equipment

Mains-frequency Induction Melting Furnace

Although Birlec, Limited, Erdington, Birmingham, manufacture a very wide range of electric furnaces, they deemed it wise about two years ago to take advantage of the experience gained by Otto Junker G.m.b.H., of Germany, and manufacture in this country mains-frequency induction melting furnaces. The difficulties of low frequency (50 to 60 cycles) were overcome by a reorientation of the electric wiring scheme. The practical considerations rule out the construction of very small furnaces and 15 cwt. is the lowest capacity furnace being manufactured, whilst at the other end of the range—at the moment—is 5 tons, both figures relating to cases where iron and steel is being melted. Efficiency increases directly with the furnace capacity and in general the electrical consumption is of the same order or a little better than arc-furnace figures. A great feature of the mains-frequency furnace is the regulatable stirring motion induced, and this has been found to be particularly useful for melting cast-iron or steel swarf or the like. Being virtually a crucible process, there is no contamination from the fuel or furnace gases and excellent material to predetermined composition can be produced at any suitable casting temperature. As nodular iron grows in volume, this may prove a useful plant for handling the turnings without the possibility of picking up sulphur or stray elements. Fig. 1 shows an 18-cwt. furnace which has been installed in the Coventry works of the British Piston Ring Company, where high-quality iron is being made from turnings. This is the first to be installed in this country. Obviously there are many other applications, as, for example, in the non-ferrous field for dealing with copper-base alloys and magnesium. This new-to-this-country furnace is one which will find its particular field in the metallurgical world and this will not be unimportant.

FIG. 1.—*Induction melting furnace of* 18-*cwt. capacity, newly installed by British Piston Ring Company, Limited.*



Hydraulic Fluid

Shell-Mex & B.P., Limited, announce that Shell F.R. hydraulic fluid, a new material combining fire-resistant properties with extremely good hydraulic characteristics, is now available in the United Kingdom and the Republic of Ireland. The new fluid applies particularly to die-casting machines and other equipment which handles material at temperatures high enough to cause ignition of mineral oils on leakage.

Productivity Council's Progress

Increased productivity is consistently hailed as a universal panacea for industrial ills; like many another medicine it has a name that is hardly euphemistic and there is some reluctance to have the dose administered. Its claims as a restorative of economic disorders are not to be denied, however, and an increased acceptance of the cure is reflected in the second progress report of the British Productivity Council published recently. An introduction to the report states that industrial productivity, particularly in manufacturing industries has been rising at a relatively high rate since 1952, when the Council was formed to carry on the work of the United Kingdom section of the Anglo-American Productivity Council.

Modestly, the Council in its report does not seek to exaggerate its own influence in this trend, but it does consider that its work has helped to focus attention on the national need for increased productivity and to stimulate action towards its attainment. It gives the main credit for this to the local productivity committees which now number 102, covering the main industrial centres. For example, in the Manchester area alone inter-works visits are taking place at the rate of 40 a month. The best firms in this country are as efficient as any in the world and the Council believes that a great deal can be done simply by passing on the experience of these companies to their less efficient competitors or counterparts in other industries.

In addition, the BPC promotes discussions, study groups, film shows, and exhibitions. Monthly it publishes a bulletin with a circulation of over 11,000, and publishes pamphlets on productivity techniques, reviews, and case studies. Prominent in the organization is the Council's work study unit, whose services are in demand. The BPC regards work study as of great importance, in that it offers the best prospects of increased productivity with little or no capital expenditure. It is significant that bids for work study lectures, practical demonstrations, and appreciation courses exceed the resources of the unit, which is booked until the middle of next year.

POWER AND LIGHT for the British Antarctic expedition will be supplied by four 7½-kva square-path, single-phase, self-regulating, self-exciting alternators manufactured by the Brush Electrical Engineering Company, Limited, at Cardiff.

Company News

OXLEY ENGINEERING COMPANY, LIMITED—In addition to maintaining the dividend at 17½ per cent., less tax, the directors recommend a bonus of 2½ per cent., tax free, for the year to June 30.

SPECIALLOID, LIMITED—The directors announce a dividend of 5½ per cent. for the year to November 15, 1949, on the £200,000 5½ per cent. cumulative preference capital. A year's preference dividend was also paid a few months ago.

GUEST, KEEN & NETTLEFOLDS, LIMITED—The directors have declared an interim dividend on £23,137,790 ordinary capital of 3½ per cent. for 1955. Last year, on half of the present capital, the interim was 5 per cent., equivalent to 2½ per cent. on the present equity.

STERLING INDUSTRIES, LIMITED—A group trading profit is announced of £51,913 for the year to March 31, 1955, against a loss of £37,728 for the previous year. No payment is recommended on the £350,000 5½ per cent. first preference capital. The dividend is in arrears from January 1, 1940.

JOHN I. THORNYCROFT & COMPANY, LIMITED, engineers and shipbuilders, of London, S.W.1—For the year to July 31, a final dividend of 10 per cent. is recommended, to make a total of 15 per cent., on £1,500,000 ordinary capital as increased by a 25 per cent. scrip issue. In the previous year a total of 15 per cent. was paid on the £1,200,000 capital.

COCHRAN & COMPANY, ANNAN, LIMITED, boilermakers—Despatches during the year to June 30 were a record, and orders are sufficient to keep the company's works fully employed for at least a year and a half at the present rate of output. Orders continue to be booked at a satisfactory rate, despite long deliveries that still have to be offered. The subsidiary had a profitable year with prospects and orders for accumulators continuing satisfactory.

WOLVERHAMPTON DIE CASTING COMPANY, LIMITED—The board is paying a final dividend of 20 per cent., making a total of 40 per cent. on £150,000 ordinary capital, for the year ended June 30. This is as forecast by the directors at the time of the one-for-two rights issue in July, which increased the equity capital to £225,000. The new shares do not rank for the dividend now declared. For the previous year an interim of 20 per cent. was paid before the 50 per cent. scrip issue in April, 1954, followed by a final of 17½ per cent. on £150,000. Group net profits have advanced sharply from £58,031 to £96,960, after tax of £92,534 (£90,686).

TUBE INVESTMENTS, LIMITED—The resolution increasing the authorized capital to £23,000,000 by the creation of 8,700,000 £1 ordinary shares was passed at the extra-ordinary meeting on October 31. Renounceable provisional allotment letters, offering to ordinary stockholders registered on October 17 7,247,431 £1 ordinary shares at 22s. 6d. per share on the basis of one for every £1 ordinary stock held, were posted on October 31, with a personal letter from Sir Ivan Stedeford, chairman, pointing out that the issue will double the company's issued ordinary capital and the rate of dividend payable on the enlarged capital will consequently be less than previously.

ASQUITH MACHINE TOOL CORPORATION, LIMITED—The board has declared a second interim dividend on the ordinary capital of 15 per cent., less tax, in lieu of a final payment. This declaration has been made, it is stated, so as to avoid any confusion which might arise when dealings commence in the Asquith shares allotted in exchange for shares of George Swift & Sons (Holdings), Limited, and which, in accordance with the terms of the offer to George Swift & Sons, are not entitled to any dividends declared by the Asquith company in respect of the year ending September 30, 1955. The 25 per cent. total for 1954-55 is as forecast in September. This maintains the rate of the previous year.

ALUMINIUM CASTINGS COMPANY, LIMITED—Turnover of the group again increased substantially in the year to March 31 last, and consolidated profits rose by about £60,000 to £265,962, before tax. The year's dividend on the 6 per cent. redeemable preference stock has been paid, but in view of continued heavy borrowings to finance current trading and of prospective capital expenditure on future developments, the directors are again unable to recommend any dividends on the £25,000 ordinary and £150,000 preferred ordinary, which are privately held and not quoted. Last dividends on these latter two classes were 20 per cent. and 11¾ per cent. respectively for 1947-48.

MILLSPAUGH, LIMITED, board- and paper-making machinery manufacturers, of Sheffield—The offer for the ordinary share capital of the company has been made by Hadfields, Limited. The offer, which is on a share exchange basis, is understood to be the best of three which have been put before the Millspaugh board. Lord Dudley Gordon, chairman of Hadfields, announces in a statement: "Now that the process of the devesting of Hadfields has been completed, the directors have been giving thought to the question of restoring the Hadfields group of companies to comprise its earlier constituents. This would involve the reacquisition of the Millspaugh group of companies."

Contracts Open

PAKISTAN, November 17—Iron and steel pipes and fittings, for the Director-General of Supply and Development, Karachi. (ESB/23044/55.)

SYRIA—Five tons of type lead, for the Director of Printing and Official Journal, Ministry of Finance, Damascus. (ESB/22918/55.)

AUSTRALIA, November 10—Diesel engines, transmissions, and associated control equipment for suburban Diesel railcars, for the South Australian Railways. (ESB/23272/55.)

FORMOSA, November 20—Piercing roll mill, for the Chung Mei Iron Works, 126, 4th Wu Fu Road, Kachsiung, Taiwan. (ESB/22958/55.)

FORMOSA—Water pumps and accessories, for the Wan Chin Trading Company, 57, Han Kou Street, Taiwan. (ESB/22967/55.)

GOOSNARGH (LANCS), November 18—Pumping equipment, with switchgear, pipework, air compression tanks, and other auxiliaries, for the Fylde Water Board. Specifications from the engineer to the board, Sefton Street, Blackpool.

SOUTH AFRICA, November 16—Hearth plates for electric annealing furnaces, for the Stores Department of the South African Railways. (ESB/23066/55.)

SOUTH AFRICA, November 25—5-ton tilting furnaces, for the Stores Department of the South African Railways. (ESB/23304/55.)

Recent Wills

YARDLEY, J. E., formerly managing director of the Wye Foundry Company, Limited, Willenhall (Staffs) £101,619

WADLOW, P. N., formerly managing director of Edge & Sons, Limited, chainmakers, etc., of Shifnal (Salop) £13,488

GRINDALL, HENRY, former secretary of the Metropolitan-Cammell Carriage & Wagon Company, Limited, Birmingham £16,311

STRONG, H. V., late chairman of Silentbloc, Limited, manufacturers of anti-vibration devices, of London, W.11, and of the Andre Rubber Company, Limited, Surbiton (Surrey) £46,536

THE South African Railways have placed an order with Beyer, Peacock & Company, Limited, Manchester, for 35 Garrett (GA) locomotives, costing about £3,000,000.

New Patents

(Copies of complete specifications are obtainable from the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)

738,979. Thos. Firth & John Brown, Limited, Atlas Works, Sheffield.

A modification of the method of producing austenitic-steel components of high yield-strength without cold working. The alloy consists of carbon 0.35 to 0.55, manganese 3.0 to 5.0, nickel 10.0 to 13.0, chromium 5.5 to 18.0, and vanadium 0.5 to 2.2 per cent. The remainder is iron, apart from the usual impurities.

738,981. Regie Nationale des Usines Renault, 8 to 10, Av. Emile Zola, Billancourt, Seine, France.

A process of manufacturing *cire-perdue* (lost-wax) casting moulds. The bond between the grains of sand of the mould is obtained by chemical reaction of a dilute solution of alkaline silicate with a building cement mixed with sand.

739,160. Mond Nickel Company, Limited, Sunderland House, Curzon Street, London, W.1.

A method by which spheroidal graphite is produced in either alloyed or non-alloyed grey cast iron. Magnesium is added to the molten metal and retained in the iron as cast. In order to ensure that a major part of the graphite is spheroidal, despite the possible presence of small amounts of titanium, some (but not more than half) of the magnesium is added as nitrided magnesium.

739,161. British Iron and Steel Research Association, 11, Park Lane, London, W.1.

A method of recuperating zinc entangled in the dross from a galvanizing bath. The dross reacts with aluminium to form an aluminium/iron alloy free from combined zinc. The zinc is simultaneously or subsequently dissolved in molten lead at high temperature. The lead is then cooled to throw part at least of the zinc out of solution.

739,212. Babcock & Wilcox Company, 161, East 42nd Street, New York, 17.

An improvement in the tapping control system of melting furnaces. An outlet for the discharge of molten metal is provided together with heating means, and means (including a radiant-energy-sensitive device situated next to the path of metal discharging from the furnace) for controlling the supply of energy to the heating system in inverse relation to the intensity of the radiant energy given off by the discharging molten metal.

739,248. Mond Nickel Company, Limited, Sunderland House, Curzon Street, London, W.1.

An alloy containing nickel 19 to 50, chromium 18 to 30, molybdenum 8 to 12, boron 0.03 to 8, carbon 0.5 to 1.5, silicon 0 to 2, manganese 0 to 3, and titanium 0 to 5 per cent. The balance apart from impurities will be iron, the iron content being at least 10 per cent. This alloy produces good properties, it is said, in the as-cast state without resort to the usual high-temperature heat-treatment. Typical articles are turbine blades.

STANTON IRONWORKS, near Ilkeston, Derbyshire, were visited on October 31, by three Japanese trade unionists in Britain on a month's visit. After touring the works they saw films of the firm's organization and discussed trade union matters with representatives of the company's workers.

Law Cases

Loose Sand blamed

An accident at the Court Works, Madeley, Salop, on July 13, 1954, resulted in an injured moulder, Arthur Skitt (67), claiming damages from his employers, Court Works, Limited, at Wellington Salop County Court, on October 25. He alleged breaches by them of the Factories Act, the Iron and Steel Foundries requirements, and negligence.

The action was heard by Judge Rowe Harding. Mr. K. Sunderland represented Skitt and Mr. F. Blennerhasset the company. The plaintiff alleged that while he was working he slipped on some sand which was covering a metal plate in the floor near the cupola in the foundry. He fractured an ankle bone which kept him away from work for 5½ weeks. His ankle pained him now in the afternoons after he had been standing. At the time of the accident, he could not see the plate because it was covered with sand.

For the company, Albert Edward Brittle, a foundry foreman, said that the plate had been put there to keep a level surface for the workmen to walk on. It had been there for 14 days before the accident and remained there for a similar time afterwards. There was a sprinkling of sand and this was considered a great help. Mr. Blennerhasset said that the Foundry Regulations envisaged the putting down of sand to deal with metal spillage, but nothing more than that. The defendants had taken all reasonable precautions to ensure a safe means of access.

His honour felt that Skitt had made out his case. At the time the plate was unsafe and was a trap. There had been a breach of the Foundry Regulations, and there was not a safe means of access under the Factories Act. There was also a breach of the safe system of working. He did not think Skitt should have his damages reduced for contributory negligence. Skitt was awarded damages of £40 with special agreed damages of £8 2s. 6d., with costs.

Metal Merchants Fined £7,000

Pleading guilty at the Old Bailey on November 1 to 20 counts of selling scrap iron in excess of the maximum permitted price, Holinter, Limited, scrap metal merchants, of London, E.C.4, was fined a total of £7,000. The company was ordered by the Recorder, Sir Gerald Dodson, to pay £500 towards the costs of the prosecution, and was given 28 days in which to pay.

Mr. E. Clarke, prosecuting, said that the prosecution arose out of contraventions of the Iron and Steel Scrap Orders under the Defence Regulations. The 20 counts in the indictment were only specimen counts, as there was in fact a far larger number of transactions. Concerning the 20 counts, he said, the excess price obtained with £2,267. In the total of the transactions the excess price obtained was £5,690 over what the metal should have been sold at.

Mr. Clarke said that in 33 months between 1951 and 1953 a Mr. Bailey, an employee of the company, had found 11 separate firms in the Midlands who were in dire need of scrap iron. He told them his company could supply scrap iron to them, but it would not pay them to sell at the permitted price. What happened then was that the transport charges were paid to the company, but it was hidden in their books with bogus invoices. The majority of firms who had bought in this way from Holinters had been prosecuted.

STERLING INDUSTRIES, LIMITED—Mr. Patrick W. Mackenzie Dean has been appointed to the board of the company and its subsidiaries.

News in Brief

BULLS METAL & MARINE, LIMITED, Bulldale Street, Glasgow, is planning to carry out extensions at Bulldale Foundry.

L. C. JAY & SON, LIMITED, formerly at 72, Salisbury Road, Norwich, have built a new non-ferrous foundry, area 6,000 sq. ft., at 19-21, Oak Street, Norwich.

SHEFFIELD is to hold a "Holland in Sheffield" week from March 3 to 10, 1956. Dr. J. M. Whittaker, vice-chancellor of Sheffield University, is chairman of the Sheffield festival organization.

AS FROM NOVEMBER 14, McKechnie Brothers, Limited, export department, will operate from their London address, 14, Berkeley Street, London, W.1. (Telephone: HYDE Park 9841/7.)

THE COUNCIL of King's College, Newcastle-upon-Tyne, has accepted a scholarship for mechanical engineering students offered by William Doxford & Sons, Limited, shipbuilders and marine engineers, of Sunderland.

THE Federation of Light Metal Smelters announces that its members' average selling prices for September, to the nearest 10s., have been calculated as follow:—LM1, £187 10s. per ton; LM2, £189; LM4, £192; LM6, £196.

FIFTY-EIGHT EMPLOYEES of Birmid Industries, Limited, Smethwick, have received long-service awards. Among the recipients were Mr. Walter Bowring, a moulder, and Mr. Bennett Jackson, a patternmaker, who have worked for the firm for 45 years.

SIR FREDERICK SCOPES, managing director of the Stanton Ironworks Company, Limited, and Lady Scopes, were guests of honour at the fifth annual dance and social of the works tennis club. It was announced that Sir Frederick Scopes had accepted the presidency of the club.

TO HANDLE sales and service of the company's products in Canada, the British Thomson-Houston Company, Limited, has formed a new company, the British Thomson-Houston Company (Canada), Limited, which is located in Toronto and will carry on the business previously handled by a branch of the organization.

IT IS NOW LEARNED that a large Midlands engineering concern is taking over Falls Foundry, Belfast—discontinued by Fairbairn Lawson Combe Barbour, Limited—as a working concern. Representatives of the concern have been in Belfast for discussions with the owners and officials of the Ministry of Commerce regarding the purchase.

R. J. RICHARDSON & SONS, LIMITED, Commercial Street, Birmingham 1, announce that last Monday they put into operation what they believe to be the largest shotblast room working for the trade in the country. The room is 30 ft. long, 12 ft. wide, and 10 ft. high, and can accommodate work up to a total weight of 10 tons. The necessary lifting equipment has been installed for dealing with likely work.

AFTER CONSULTATION with the North Eastern Division of the Central Electricity Authority and the North Eastern Electricity Board, the Northern Regional Board for Industry has decided that the North-East Coast area will be free from formal electricity load-spreading during the coming winter, unless extremely severe weather is encountered. It is stressed, however, that economy will still be necessary at peak hours.

HARTLEPOOL'S new deep-water berth to accommodate ships of 10,000 tons will be ready on November 21, the Hartlepool Port and Harbour Commissioners were told at their meeting on November 1. The cost has been £500,000 and the work has included the reconstruction of an old quay at the port, which has been lengthened to 680 ft., and the erection of five electric cranes. Floodlighting for after-dark working is to be fitted.

ONE OF THE EARLIEST known pieces of British pewter has been discovered at Weoley Castle, Birmingham. It is a decorated communion cruet thought to date from the first quarter of the fourteenth century. The discovery was made by Mr. Adrian Oswald, keeper of the Department of Archaeology, in the Birmingham City Museum on the last day of the recent, first post-war season of excavation at the site.

THE Power-Gas Corporation, Limited, has been appointed by the Billingham division of Imperial Chemical Industries, Limited, to act as main contractors in connection with a substantial extension of the ICI ammonia synthesis gas plant. The plant will be built under the overall technical direction of ICI, which is designing the oil gasification units in accordance with information supplied by the Texaco Development Corporation.

A TOKYO REPORT states that the Japanese Ministry of Trade has announced that exports of certain iron and steel products, which were suspended in mid-October, will be approved in cases where letters of credit were received before imposition of the ban. The Ministry has also stated that special treatment will be given to contracts made with foreign governments before the suspension, and to shipments meeting obligations under barter contracts.

SCOTTISH engineering and shipbuilding products are among the exhibits being displayed at the International Industrial Exhibition in the Royal Scottish Museum, Edinburgh, which was opened by Lord Bilsland, president of the Scottish Council (Development and Industry) on November 5. The exhibition is being held in conjunction with the Junior Chamber International World Congress, which is being held in Edinburgh for a week ending Saturday.

MECHRON ENGINEERING PRODUCTS, LIMITED, of Ottawa, Ontario, one of the Canadian agents for W. H. Dorman & Company, Limited, of Stafford, have been awarded a contract, valued at two million dollars, by the Department of Defense Production, for a considerable number of electric generating sets for the Mid-Canada DEW (distant early warning) stations. These sets will be powered by Dorman "L" series diesel engines which will be manufactured at the Tixall Road factory.

FOLLOWING a merger with Aveling-Barford, Limited, Grantham, there will be some reorganization at the Leicester engineering works of Goodwin Barsby & Company, Limited, including the increase of foundry production to the maximum capacity in the existing buildings. The machine shops and stores are also to be modernized. The manufacture of certain machines is to be transferred to the Belton works of Barford Agriculture, Limited, but the sales organization will remain in Leicester.

FEWER new industrial assurance policies were taken out last year than in any year since the war, but the amount assured by this new business, £287,100,000, was the highest figure ever reached. Compared with the previous year, new business was up by £8,400,000, although it was only about £300,000 more than the previous record for 1947. These figures are quoted by Mr. C. B. Crabbe, the Industrial Assurance Commissioner, in his annual report published recently (Stationery Office, 3s. 6d.).

News in Brief

THE MOST RECENT installation of long-welded rails completed on British Railways is a length of 1,800 yards of track at Crewkerne in the Southern Region. The rails were first welded in a depot into lengths of 300 ft. by the electric flash-butt method and these lengths were subsequently joined at site by "Thermit" welding. The rail is laid on concrete sleepers and the finished track contains reverse curves of 100 and 58 chains radius. Thirty-five trains a day travel on this line at speeds up to 80 miles an hour.

THERE ARE SITES IN SHEFFIELD which would provide the city with a heli-port second to none in the country, said Mr. Eric Mensforth, chairman of Westland Aircraft, Limited, when he addressed the Sheffield branch of the Incorporated Sales Managers' Association, on November 3. He said Sheffield could have a service in ten years' time—"but, in spite of slow development of the helicopter, it will be here before the city authorities are ready to receive it." He foresaw a passenger service costing sixpence or sevenpence a mile.

SPEAKING IN A SERIES OF LECTURES on "Personnel Problems of Management" arranged by the Walsall and District Productivity Committee at Wednesbury County Commercial College on November 1, Dr. Frank T. Pearce, of Tube Investments (Export), Limited, estimated the financial effect of labour turnover to be between £5 and £15 for each unskilled workman and between £50 and £100 for every skilled workman. Dr. Pearce arrived at these cost figures as a result of a comprehensive investigation he undertook two years ago at Birmingham University.

TO OBTAIN INFORMATION on present conditions in some South American markets, Mr. Rodney Kent, sales director of George Kent, Limited, is to spend a month in that area. He left by air on November 6, and will visit Kent agencies and principal customers, including the oil industry and many municipalities, in Brazil, Uruguay, Argentina, Venezuela, Cuba and Mexico. While in Argentina, he will, as a director of Agar, Cross & Company, Limited, London, New York and Buenos Aires, work in close association with the Agar Cross head offices in Buenos Aires.

THE KEYNOTE of research for the future success of Britain, was stressed by Sir Harold Hartley, when he addressed 900 industrialists at the opening session of the British Institute of Management conference at Harrogate on November 2. He said that "the economic future of Britain depends on her exports and these are increasingly dependent on those fields where science and technology are the major factors. As other countries are industrialized we must live by exporting technical 'know-how' and securing contracts for the design and construction of major works overseas."

EMPLOYEES at the Lancashire factories of Leyland Motors, Limited, are counting the number of "suggestion days" to Christmas, when additional awards totalling £350 are to be made for the best suggestions of the year. With only a few weeks to go signs of increasing activity are evident in the ideas now being received—one out of every three of those considered during recent weeks received an award. In addition to the awards made for ideas actually accepted and put into practice, other awards were also made for suggestions which drew attention to difficulties, though without offering any practical solution.

IT WAS DECIDED at a recent meeting of the Council of the Institution of Production Engineers to set up a special committee to investigate the full implications of automation. The chairman of the committee will be Mr. A. F. Kelley, B.SC. Other members of the committee are Sir Leonard Lord, K.B.E. (president of the Institution); Mr. G. R. Pryor and Mr. H. G. Gregory, chairman and vice-chairman of Council, respectively; Mr. E. W. Hancock, M.B.E.; Sir Walter Puckey (immediate past-president of the Institution); Mr. B. H. Dyson; the Earl of Halsbury; Mr. M. Seaman; Mr. R. Telford; and Mr. F. G. Woollard, M.B.E.

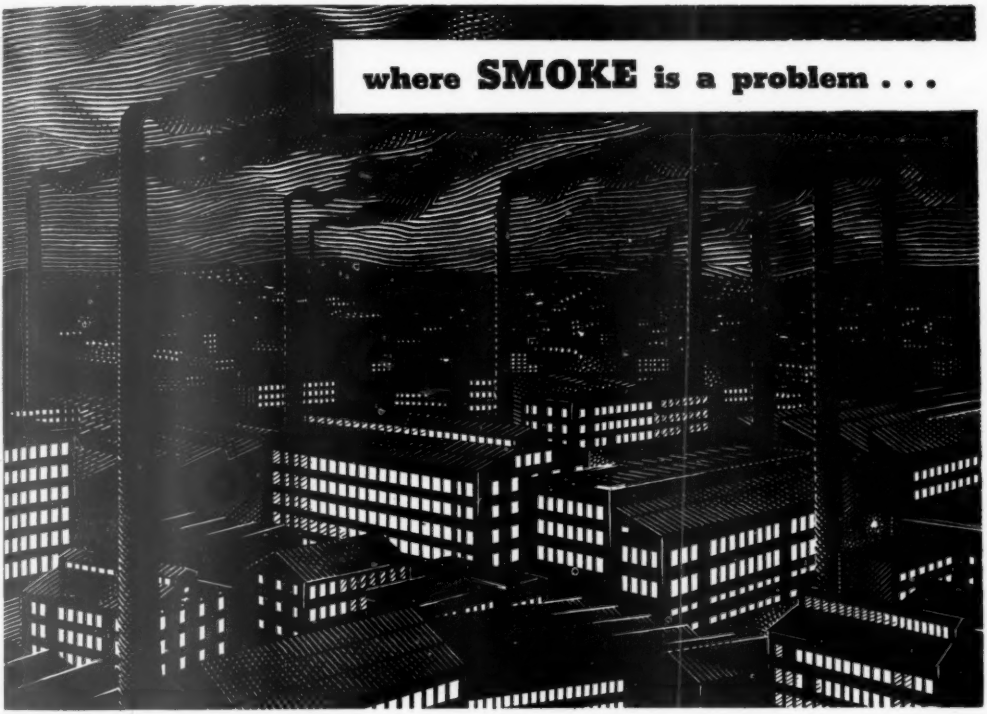
AN ORDER valued at well over £250,000 has been obtained by the British Thomson-Houston Company, Limited, Rugby, from the National Coal Board (N.E. Division, No. 2 area) for two automatically-controlled, tower-mounted, electrically-driven, 4-rope friction winders for Brodsworth Colliery in Yorkshire. These winders are required in connection with a large reconstruction scheme at the colliery and will eventually replace the existing steam winders now operating in Nos. 1 and 2 shafts. BTH will be main contractors for the winder installation including the electrical portions and the main reduction gears. The sub-contract for the mechanical portions has been placed by BTH with Markham and Company, Limited, of Chesterfield. It is expected that both equipments will be installed during 1958.

BRITISH CAR MANUFACTURERS may receive orders from Russia after the report of a trade delegation which is on a ten-day visit to this country, the leader of the delegation, Mr. A. F. Ivanov, Deputy Minister of Transport, said in Coventry on November 1. The party of 11, which included Mr. A. M. Krieger, chief designer of the car industry, visited the works of the Standard Motor Company, Limited, and Daimler, Limited. Mr. Ivanov said that they had been impressed with the conveyor system at the factories and from a technical point of view the organization was good. The delegation was impressed with the diesel engines shown and thought these could be used in Russia to a much greater extent. On November 2, the Russians visited the works of Guy Motors, Limited, and the Turner Manufacturing Company, Limited.

THE FIRST MEETING of the British Nuclear Energy conference will be held on November 30, from 2.15 to 8.15 p.m., at the Institution of Civil Engineers. It will take the form of a lecture symposium and will be opened by the chairman, Sir Christopher Hinton, M.A. Lectures will include "United Kingdom Atomic Energy Project," by Sir John Cockcroft, K.C.B.; "Place of Nuclear Energy in United Kingdom Power Development," by V. A. Pask, C.B.E., and J. C. Duckworth, B.A.; "Use of Research Reactors in Nuclear Power Development," by H. J. Grout, B.SC.; and "Health and Safety in a Nuclear Power Industry," by A. S. Maclean, M.B., CH.B., and W. H. Marley, M.SC., PH.D. The symposium will be confined to members of the Institutions of Civil Engineers; Mechanical Engineers; Electrical Engineers; Chemical Engineers; and the Institute of Physics. Those who wish to attend are requested to apply for tickets as soon as possible to the secretary of the society of which they are a member.

Guildhall Safety Conference

The major lesson emanating from this conference was a statement by Sir Ewart Smith that the incidence of accidents decreased when the managing director was an enthusiast on the subject, but they rose when there was lack of personal interest. Accidents are of outstanding importance to the foundry industry so it is recommended that the highest executives in each concern give continuous attention to the subject.



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Personal

BIRLEC, LIMITED, announce that MR. T. G. TANNER, technical director of the company, has been appointed deputy managing director with effect from October 31.

AT THE ANNUAL GENERAL MEETING of the Chemical Club held at 2, Whitehall Court, London, S.W.1, on October 31, DR. E. H. T. HOBLYN was elected president in succession to MR. F. E. WARNER.

Mr. JOHN BALMAIN, general manager and director of Hillside Foundry, Cupar, Fife, flew from Prestwick on November 2, bound for the USA, where he will give special study to fish unloading and water distillation plant.

SIR JOHN KEELING has resigned as a director of Fairbairn Lawson Combe Barbour, Limited, engineers and textile machinery manufacturers, Leeds. Mr. A. R. Gow, a director of one of the subsidiaries, has been appointed in his place.

LORD HIVES, executive chairman of Rolls-Royce, Limited, and Mr. S. BAUER and Mr. D. C. BOADLE, two of his senior engineers, are on a business visit to America. It is expected that they will meet high executives in the aviation industry.

Mr. H. T. RENOUF has been appointed United Kingdom trade correspondent in Newfoundland, to replace Miss W. CALDWELL, M.B.E., who has retired. His address is: Newfoundland Board of Trade, Water Street, St. John's, Newfoundland.

Mr. LESLIE SEYMOUR, a metal goods manufacturer, of Sparkbrook, Birmingham, has been recommended for adoption as prospective Parliamentary candidate, for the Sparkbrook Division, by the executive committee of the local Conservative Association.

Mr. JOHN SHIRREFF has been appointed vice-president of Johnson, Matthey & Mallory, Limited, the Canadian associate of Johnson, Matthey & Company, Limited. He joined the parent company in 1927 and in 1949 accepted a position with the Canadian associate, since which time he has been principally concerned with sales.

MONSANTO CHEMICALS, LIMITED, announce that MR. PHILIP A. SINGLETON has resigned from the board in order to take up a new appointment with Monsanto Chemical Company, St. Louis, USA. At the same meeting, MR. D. R. MACKIE, commercial director, was appointed acting managing director of the former company.

MR. R. J. BARRITT has been appointed managing director of the Metallurgical Equipment Export Company, Limited, of 19, Victoria Street, Westminster, and its associated organization, the Indian Steelworks Construction Company, Limited. Mr. Barritt was formerly with Simon-Carves, Limited. He will take up his new appointment before the end of the year.

MR. D. R. O. THOMAS, chief education officer of the United Steel Companies, Limited, left Sheffield on November 5, for a two-week visit to Germany. He goes as a member of a team of leading British educationists who are to study German arrangements for day release education. Places to be visited by the group include Cologne, Dusseldorf and the Ruhr, Bremen and Hamburg.

Mr. H. A. BROWN has retired from the position as technical sales engineer to the firm of Plowright Bros., Limited, ironfounders and colliery engineers, Chesterfield, after completing 49 years' service. To mark his retirement, he was the guest of honour at a luncheon held at the firm's headquarters, The Manor, Brompton, when he was presented with a gold watch. The presentation was made by Mr. ROBERT PLOWRIGHT, chairman of the directors.

MR. T. P. N. BURNESS, who retired a month ago from the position of joint managing director of William Asquith, Limited, machine tool makers, Halifax, was the recipient, at a ceremony at the firm, of gifts in the form of a silver letter-rack from members of the sports club and a cheque from the employees. Mr. Burness was a director of the Asquith Machine Tool Corporation, Limited, and managing director of Modern Foundries, Limited, since 1939, and will remain on the corporation board. He is also chairman of Ambrose Shardlow and Company, Limited, engineers, of Sheffield.

THE MINISTER OF LABOUR AND NATIONAL SERVICE announces that Her Majesty the Queen has been pleased by warrant under Her Majesty's Royal Sign Manual to appoint Mr. DESMOND WEST EDMUND NELIGAN, barrister at law, to be umpire under the National Service Act, 1948, in succession to Mr. JOHN HARCOURT BARRINGTON who has resigned on his appointment as a County Court Judge. Her Majesty has been pleased likewise to appoint Mr. CLIFFORD MIDDLETON, barrister at law, to be deputy umpire in place of Mr. Neligan. The duties of the umpire and deputy umpire under the National Service Act are to hear and decide appeals against the decisions of Reinstatement Committees and the determinations of Military Service (Hardship) Committees respectively.

Obituary

MR. HARRY D. HEWITT, local director and general sales manager, of Firth-Vickers Stainless Steels, Limited, Sheffield, has died at the age of 60.

Mr. EDWIN RUSHWORTH, managing director of E. Rushworth & Sons, Limited, ventilating engineers, of Leeds, which he founded 45 years ago, has died at the age of 65.

THE DEATH is announced of MR. SEYMOUR BOOTH, a director of the British Vacuum Cleaner & Engineering Company, Limited, Leatherhead, Surrey. Mr. Booth joined the organization in 1904 when he was 30 years old.

MR. WILLIAM THOMSON SHARP, of Falkirk, who has died at the age of 66, was a director and secretary of Sharp & Sons, Limited, engineers, Union Road, Camelon. He was the sole surviving son of William B. Sharp, who founded the business in 1884.

Mr. GEORGE HEATH, a pioneer of the motor industry, died at Birmingham, on November 3, at the age of 79. He was a director of Rootes, Limited, and chairman of George Heath, Limited, a business which he founded. A Birmingham man, Mr. Heath claimed to be the first motor-car dealer in the Midlands. Among his many friends were Henry Ford, André Citroen and M. Mathis the French designer.

Mr. WILLIAM HENDRA, after a short illness, died at his home in Sutton, Surrey, on November 3. He started work in the ironfounding industry in 1891, in the business of H. Hendra & Son, which was founded by his grandfather in 1864. From the death of his father in 1913, he was proprietor until his retirement in 1941. He always maintained a great interest in the trade and until a few weeks ago took parties of schoolboys around the works, explaining the art and craft of an industry with which he was proud to be associated. Mr. Hendra was a member of the London branch of the Institute of British Foundrymen, having joined in 1928.

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Raw Material Markets

Iron and Steel

Delay in the expansion of pig-iron production has created an awkward bottleneck. Bigger outputs are being obtained from the blast furnaces in operation, but there are not enough of them, and the lighting of additional units cannot come too soon. The provision of more basic iron is in sight, as several new blast furnaces are approaching completion, but as yet there is no hint of that increased supply of hematite and low-phosphorus iron which is so obviously needed on the foundry trade.

Deliveries of common foundry iron are distinctly easier, and the Budget proposals may tend to limit the flow of order for domestic castings, but the engineering and speciality foundries have all the work they can cope with, and they cannot continue to maintain full employment for an indefinite period without an ampler supply of low-phosphorus or hematite iron.

There are no visible limits to the demand for sheet and strip, and re-rollers of small bars and light sections have in hand an impressive volume of orders which includes a substantial proportion of export business. Fortunately, they are now receiving better supplies of steel semis in the form of billets, blooms, sheet bars, and slabs and the mills are operating as close to capacity limits as the labour situation permits.

The congestion of orders and the mounting arrears in deliveries of finished steel products are becoming a positive embarrassment, and it is no consolation to British consumers to be assured that similar conditions are developing abroad. United States steel production is running at record heights and in Germany it is reported that delivery periods for finished steel vary between three and 12 months.

British rollers are chary of accepting any more business for the first half of next year and it looks as though the squeeze will continue. Not only flat steel products but joists and sectional material also are eagerly sought; but it is difficult to place an order and it will be a relief if the requirements of the nationalized industries are reduced.

Non-ferrous Metals

Uneasiness over the Chilean labour situation and the disturbing course of events in the Middle East have tended to push copper prices higher in London, although some reaction followed Friday's spurt to £380 caused by disquiet about Chile. Last week's stoppage at El Teniente, Chuquicamata, and Potrerillos was declared as a 24-hour token strike against resolutions contained in the Government's new labour code. At the same time the unions threatened a general strike if workers' wage claims for an automatic annual wage increase were rejected. A truce would seem to exist, since the miners have gone back to work, while the Government has promised to reconsider their claims.

With unrest on the Rhodesian Copperbelt, fears of a break in copper production and a consequent tightening of supplies is adding firmness to the copper price in London. Moreover, stocks in London Metal Exchange warehouses continue to fall.

Official stocks of tin are still dwindling and demand continues to be strong both here and in New York. On the news of a settlement of the 18-day strike in the Nigerian tinfields, the price fell back a few points. In New York the settlement knocked the price down from 97 cents to 96.75 cents a pound. Reports indicate that the stoppage cost 303 tons of tin and columbite. Tinplate consumption is at a high level and is expected to remain so in 1956. In fact, some US consumers are reported to be stockpiling tinplate against the possibility of a strike in the US steel industry next year.

Lead remains a steady market. Price fluctuations are small and consumption is good. The market position in the States is much the same, with the possible exception that the automobile industry envisages an output of cars in 1956 comparable to this year, thereby presaging a good demand from battery makers, while here increased purchase tax and the continuation of the credit squeeze may result in cutting back some consumption by the building and battery industries.

The zinc market has been steady, but dull, on both sides of the Atlantic.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* November 3, £364 to £365; November 4, £378 to £380; November 7, £371 to £372; November 8, £369 to £370; November 9, £370 to £371.

Three Months: November 3, £350 10s. to £351; November 4, £364 to £365; November 7, £355 10s. to £356; November 8, £355 to £356; November 9, £357 10s. to £358 10s.

TIN, Standard—*Cash:* November 3, £768 to £770; November 4, £768 to £769; November 7, £769 to £770; November 8, £769 10s. to £770; November 9, £766 to £767.

Three Months: November 3, £750 to £752; November 4, £752 to £752 10s.; November 7, £751 10s. to £752 10s.; November 8, £751 to £752; November 9, £750 to £751.

LEAD—*First half November:* November 3, £106 5s. to £106 10s.; November 4, £106 10s. to £106 12s. 6d.; November 7, £106 10s. to £106 15s.; November 8, £106 10s. to £106 12s. 6d.; November 9, £106 17s. 6d. to £107.

First half February: November 3, £106 to £106 5s.; November 4, £106 5s. to £106 7s. 6d.; November 7, £106 5s. to £106 10s.; November 8, £106 7s. 6d. to £106 10s.; November 9, £106 12s. 6d. to £106 15s.

ZINC—*First half November:* November 3, £90 15s. to £91; November 4, £91 to £91 5s.; November 7, £91 to £91 5s.; November 8, £91 2s. 6d. to £91 5s.; November 9, £91 10s. to £91 15s.

First half February: November 3, £90 5s. to £90 10s.; November 4, £90 10s. to £90 12s. 6d.; November 7, £90 5s. to £90 10s.; November 8, £90 10s. to £90 15s.; November 9, £90 15s. to £91.

Colombo Plan Students

The courses arranged in Britain for Colombo Plan students under the technical co-operation scheme cover a wide variety of subjects. Among the more recent have been: medical radio-diagnosis; the British taxation system; hydraulic engineering and foundry methods. Six Indian trainees have just started a diploma course in foundry operations at the National Foundry College, Wolverhampton. They are: Mr. R. M. Krishnan, senior scientific assistant, National Metllurgical Laboratory, Jamshedpur; Mr. V. Reddi, foundry manager, Jay Engineering Works, Calcutta; Mr. D. H. Date, deputy foundry engineer, Mukand Iron and Steel Works; Mr. B. L. Rao, a metallurgist with Kirloskar Brothers, Satara; Mr. A. K. R. Chowdhury, a chargeman at the Locomotive Repair and Maintenance Shop, Jamalpur, and Mr. N. K. Ghosh, foundry engineer, India Electric Works, Limited.

INTERNATIONAL COMBUSTION (HOLDINGS), LIMITED—Sir James Reid Young has been appointed deputy chairman.

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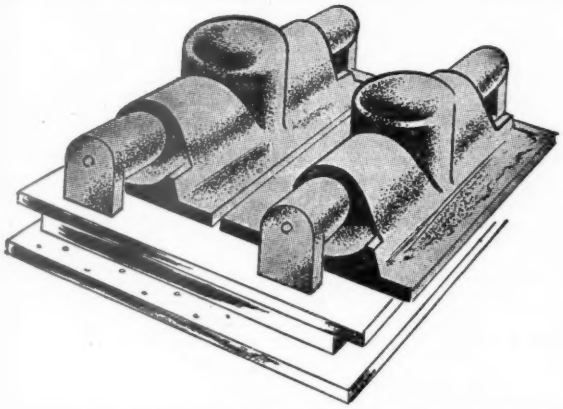

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

November 9, 1955

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £17 1s. 0d.; Birmingham, £16 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £18 12s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £19 8s. 3d.

Scotch Iron.—No. 3 foundry, £19 5s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £21 3s. 0d.; South Zone, £21 5s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £22 0s. 0d.; South Zone, £22 3s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent. :—N.-E. of England (local iron), £19 5s.; Scotland (Scotch iron), £19 11s. 6d.; Sheffield, £20 12s. 0d.; Birmingham, £20 19s. 6d.; Wales (Welsh iron), £19 11s. 6d.

Basic Pig-iron.—£16 16s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £43 15s. 0d., scale 15s. per unit; 75 per cent. Si, £65 0s. 0d., scale 16s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £230 0s. 0d.; 38/40 per cent., £279 0s. 0d.

Ferro-tungsten.—80/85 per cent., 17s. 2d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 20s. 2d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £85 0s. 0d. to £90 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. to 30s. 0d. per unit; over 6 per cent. C, £82 0s. 0d. to £86 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C* 1s. 11¾d. per lb. Cr.; 1 per cent. C,* 2s. 0¼d. per lb. Cr; 0.15 per cent. C,* 2s. 2¼d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £249 0s. 0d.; 96/98 per cent., £269 0s. 0d.

Ferro-columbium.—60/75 per cent., Nb + Ta, 28s. per lb., Nb. + Ta.

Ferro-manganese (home).—78 per cent., £54 10s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £26 19s. 0d.; tested, 0.08 to 0.25 per cent. C, £27 19s. 0d.; hard (0.41 to 0.60 per cent. C), £29 5s. 6d.; silico-manganese, £36 7s. 6d.; free-cutting, £31 0s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £34 12s. 0d.; silico-manganese, £36 7s. 6d.

* Average 68-70 per cent.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £31 11s. 0d.; basic, hard, over 0.41 up to 0.60 per cent., C, £32 13s. 6d.; acid, up to 0.25 per cent. C, £35 12s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £33 1s. 6d.; boiler plates (N.-E. Coast), £35 11s. 6d.; floor plates (N.-E. Coast), £34 10s. 6d.; sectional material, N.-E. Coast, £30 19s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £33 19s. 6d.; flats, 5 in. wide and under, £33 19s. 6d.; hoop and strip, £35 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £36 5s. 0d.; black sheets (hand mill), 17/20 g., £46 13s. 6d.; galvanized corrugated sheets, 24 g., £58 11s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £58 0s. 3d.; nickel-chrome, £81 10s. 0d.; nickel-chrome-molybdenum, £92 7s. 6d.

NON-FERROUS METALS

Copper.—Cash, £370 0s. 0d. to £371 0s. 0d.; three months, £357 10s. 0d. to £358 10s. 0d.; settlement, £371 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 3s. 6¾d. per lb.; rods, 415s. 0d. per cwt. basis; 20 s.w.g., 448s. 3d. per cwt.

Tin.—Cash, £766 0s. 0d. to £767 0s. 0d.; three months, £750 0s. 0d. to £751 0s. 0d.; settlement, £767 0s. 0d.

Lead (Refined Pig).—First half November, £106 17s. 6d. to £107 0s. 0d.; first half February, £106 12s. 6d. to £106 15s. 0d.

Zinc.—First half November, £91 10s. 0d. to £91 15s 0d.; first half February, £90 15s. 0d. to £91 0s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £122 10s. 0d.; rolled zinc (boiler plates), all English destinations, £120 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £103 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 9¾d. per lb.; rods, drawn, 3s. 7¼d.; sheets to 10 w.g., 356s. 6d. per cwt.; wire, 3s. 4¾d.; rolled metal, 342s. 3d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £220; B6 (85/15), —; BS249, £234.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £276; HTB2 (38 tons), £285; HTB3; (48 tons), —.

Gunmetal.—RCH, 3/4 per cent. tin. —; BS1400, LG2 (85/5/5/5), £315; LG3 (86/7/5/2), £325; G1 (88/10/2/½), £383; (88/10/2/1), £375.

Phosphor Bronze.—BS1400, PB1 (AID released), £397 per ton.

Phosphor Bronze Strip, etc.—Strip, 501s. 6d. per cwt.; sheets to 10 w.g., 525s. 0d. per cwt.; wire, 5s. 1¼d. per lb.; rods, 4s. 5½d.; tubes, 4s. 3¾d.; chill cast bars: solids 4s. 6d., cored 4s. 6½d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 4½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 9d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 8d. All prices are net.

Other Metals.—Magnesium. ingots, 2s. 4d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £90 10s. 0d. to £91 5s. 0d. Nickel, £519 0s. 0d. Aluminium, ingots, £171 0s. 0d.; aluminium bronze, (BS1400), AB1, £363; AB2, —. Solder, brazing, BS1945, 3s. 1d. lb.; granulated, 3s. 4½d. lb.